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SERVICE MANUAL No. I-0320

MULTIPOINT FLOW SELECTOR

CUSTOMER:	
P.O. #	
W.O. #	
TAG:	
DATE:	
OPERATOR MODEL	

I-0320--.DOC/1
REV 1: AUG-31-04

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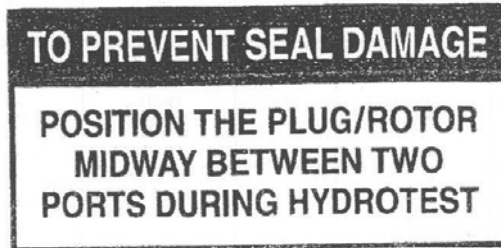
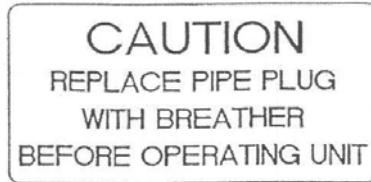
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Additional manuals:

Multipoint Electronic Controller Model MP-08 – Service Manual I-0168

Multipoint Electronic Controller Model MP-800 – Service Manual RD-00232

OBSERVE ALL WARNING DECALS AND TAGS



MINIMUM TOOLS REQUIRED:

A torque wrench, socket wrench, and allen head wrenches are required to install the Multiport and Actuator assembly.

MULTIPORT SIZE	NPS 2"	NPS 3" ANSI 600	NPS 3" ANSI 900/1500	NPS 4" ANSI 600	NPS 4" ANSI 900
BONNET NUT SOCKET SIZE	1 7/16"	2"	2 3/8"	2 3/8"	2 9/16"

Other socket sizes required: 7/16", 1/2", 9/16", 3/4", 1 1/8".

Allen key sizes required: 5/32", 1/4".

Wrench sizes for Multiport flanges:

ANSI RATING	300	600	900	1500
NPS 2	1 1/16	1 1/16	-	-
NPS 3	-	1 1/4	1 7/16	1 13/16
NPS4	-	1 7/16	1 13/16	2
NPS 6	-	1 5/8	1 13/16	2 3/16
NPS 8	-	1 13/16	2 3/16	-

I INTRODUCTION

As many as eight flow-lines can be manifolded through one BETTIS Multiport Flow Selector. The multiport allows diversion of an individual flow-line to a test outlet for testing or sampling, while combining the flow of the other flow-lines into a separate group outlet.

II MULTIPORT SPECIFICATIONS

TRIM	RATING		SIZE	ANSI 300RF CONNECTION			WEIGHT MULTIPORT lbs.
	MAXIMUM WORKING PRESSURE PSIG	WORKING TEMP EC		EIGHT FLOWLINE INLET PORTS	ONE TEST OUTLET PORT	ONE GROUP OUTLET PORT	
STD.	740	38	3x6	NPS 3	NPS 3	NPS 6	800
HIGH TEMP	600	260					
STD.	740	38	4x8	NPS 4	NPS 4	NPS 8	1275
HIGH TEMP	600	260					

TRIM	RATING		SIZE	ANSI 600RF CONNECTION			WEIGHT MULTIPORT lbs.
	MAXIMUM WORKING PRESSURE PSIG	WORKING TEMP EC		EIGHT FLOWLINE INLET PORTS	ONE TEST OUTLET PORT	ONE GROUP OUTLET PORT	
STD.	1000	200	2x4	NPS 2	NPS 2	NPS 4	180
HIGH TEMP	1440	260					
STD.	1440	38	3x6	NPS 3	NPS 3	NPS 6	860
HIGH TEMP	1200	260					
STD.	1480	38	4x8	NPS 4	NPS 4	NPS 8	1375
HIGH TEMP	600	260					

TRIM	RATING		SIZE	ANSI 900RF CONNECTION			WEIGHT MULTIPORT lbs.
	MAXIMUM WORKING PRESSURE PSIG	WORKING TEMP EC		EIGHT FLOWLINE INLET PORTS	ONE TEST OUTLET PORT	ONE GROUP OUTLET PORT	
STD.	2220	38	3x6	NPS 3	NPS 3	NPS 6	1800
HIGH TEMP	1795	260					
STD.	2220	38	4x10	NPS 4	NPS 4	NPS 10	3200
HIGH TEMP	1795	260					

TRIM	RATING		SIZE	ANSI 1500RF CONNECTION			WEIGHT MULTIPORT lbs.
	MAXIMUM WORKING PRESSURE PSIG	WORKING TEMP EC		EIGHT FLOWLINE INLET PORTS	ONE TEST OUTLET PORT	ONE GROUP OUTLET PORT	
STD.	3705	38	3x6	NPS 3	NPS 3	NPS 6	1875
HIGH TEMP	2995	260					

MULTIPOINT SIZE AND RATING	NPS 2" ANSI 600	NPS 3" ANSI 600	NPS 3" ANSI 900/1500	NPS 4" ANSI 600	NPS 4" ANSI 900
TEST OUTLET C _v	67	151	100	270	218
GROUP OUTLET C _v	262	594	429	1040	830
SHELL HYDROSTATIC TEST PRESSURE PSIG (KPa)	2200-2220 (13780-15300)	2160 (14900)	5560 (38310)	2220 (15300)	3330 (22950)

MULTIPOINT SIZE AND RATING	MAXIMUM DYNAMIC DIFFERENTIAL PSID @ 40EC		STATIC STATIONARY DIFFERENTIAL PSID @ 40EC	
	TEST-GROUP	GROUP-TEST	TEST-GROUP	GROUP-TEST
NPS 2X4 ANSI 600	600	550	1200	900
NPS 3X6 ANSI 60	500	450	1000	700
NPS 3X6 ANSI 900/1500	500	450	1000	700
NPS 4X8 ANSI 600	400	350	800	600
NPS 4X10 ANSI 900	400	350	800	600

Note: In Emergency situations only, the Multiport Flow Selector seal can maintain STATIC STATIONARY DIFFERENTIAL pressure rating per specifications above. However, do not operate the motor operator at greater than the MAXIMUM DYNAMIC DIFFERENTIAL pressure rating because damage may occur to the motor operator.

IIB ACTUATOR SPECIFICATIONS:

MULTIPOINT SIZE AND RATING	NPS 2" ANSI 600	NPS 3" ANSI 600	NPS 3" ANSI 900/1500	NPS 4" ANSI 600	NPS 4" ANSI 900
PLUG POSITION TOLERANCE	+/- 2E	+/- 2E	+/- 2E	+/- 2E	+/- 2E
BREAKAWAY TORQUE @ MAX DIFFERENTIAL	100-125 FT-LBS	100-170 FT-LBS	150-200 FT-LBS	150-210 FT-LBS	150-210 FT-LBS
ACTUATOR SPEED	1.4 RPM	1.4 RPM	1.4 RPM	1.4 RPM	1.4 RPM
ACTUATOR WEIGHT	50 LBS	130 LBS	130 LBS	130 LBS	150 LBS
PLUG POSITION ACCURACY	+/- 1E	+/- 1E	+/- 1E	+/- 1E	+/- 1E

III MULTIPORT INSTALLATION

Before installing the unit, observe all warning tags and:

1. Check for external physical damage.
2. Check for any visible leakage of gear oil from the speed reducer (426).
3. Visually inspect the inside of the multiport through the group outlet port checking for damage, rust, and debris.
4. Check the wiring arrangement using the attached diagram on page 17 or as supplied for a particular order/unit.
5. Verify the voltage requirement of the motor (AC/DC) and connect power supply and signal circuits to test the operation of the motor (438) and plug. Check for proper plug seal alignment at each port.

NOTE: The Multiport Flow Selector plug seal/port alignment is factory adjusted when supplied with actuator and should not require further adjustment.

6. Connect piping.

NOTE: When hydrotesting external piping, position the plug between any two inlet ports in order to equalize test pressure between the multiport body and external piping and prevent possible seal damage from occurring.

IIIB FIELD TECHNICIAN COMMISSIONING ACTIVITIES

Refer to the Multiport Electronic Controller service manual I-0168 for detailed commissioning activities.

CAUTION:

The valve body may be pressurized from hydrostatic testing - do not remove any bolts or flanges for inspection until after the unit has been depressurized.

The connector and pointer are potential pinch points for fingers when the unit is rotating - keep hands clear of the unit during operation.

Circuit boards are susceptible to damage from static discharge when touched - ensure that you ground yourself before touching the JOG, ZERO, and HOME buttons on the electronic controller board.

NOTE: Locate the reference mark (a centre punch mark) on the flat section of the stem to indicate the orientation of the plug seal. The mark should be visible between the flats of the lower section of the connector when assembly is completed and is to be used as a reference indicating the plug seal location in the body (See photo, page 22).

A. REINSTALLATION OF THE ACTUATOR ASSEMBLY (also refer to section VII)

NOTE: The indicator plate (402) must be set in place as the motor/gearbox is lowered onto the valve body.

1. Using a manual wrench, rotate the plug assembly two or three revolutions to verify that it turns freely. Initial effort required to turn the plug may be high as the seal will typically acquire some set from sitting for extended periods of time. Turn the plug until the reference mark is aligned

with the #6 well connection. This allows for the installation of the connector pin. Note that installing the pin may require electrical power so that the upper section of the connector can be rotated to align the bolt hole.

2. Install the lower section of the connector onto the stem flat. Orient the lower section of the connector so that the indented mark is visible between the flats.
3. Install the two studs (1/2NC) diagonally opposite one another (180° apart).
4. Lower the actuator assembly over the studs, placing the indicator plate over the studs. Lower the actuator assembly until it rests on the bonnet.
5. Install the two bolts (1/2NC X 1.25LG) to secure the assembly to the bonnet.
6. Install the lower nuts on the studs.
7. Tighten all bolts and nuts finger tight only.
8. With the connector sections aligned, install the connector bolt. Note that this may require electrical power to rotate the connector and align bolt holes.
9. Install the spacers, indicator plate, and upper nuts on the studs. Leave the nuts loose, to be tightened later when alignment is completed (step 11, below).
10. Wrench tighten the two bolts and lower nuts.

NOTE: Refer to electrical drawings and wiring diagrams for electrical power terminal connection and motor voltage.

11. After connecting power to the motor, rotate the plug two revolutions to align the connectors. Visually check for any binding and adjust as necessary. After ensuring correct alignment, wrench tighten all bolts and nuts.

B. HOME PORT CALIBRATION (I-0168/RD-00232 Section H)

1. Using the JOG button, align the connector sections to install the connector bolt and tighten the connector set screw.
2. If possible, remove the blind flange on the home port (port #8) and use the JOG button (tap briefly for fine movement of the plug) on the controller circuit board to “fine tune” the plug seal/port alignment.
3. Follow the procedure in the Multiport Electronic Controller Manual for home port calibration (set zero).
4. When finished, align the hex corner of the lower connector with the appropriate slot on the indicator plate. The pointer should also line up with the slot on the indicator plate.
5. If the unit has the optional local control push button station, select step mode and press the button. The plug should move automatically to the next available port and slowly step into position. Verify this by observing the hex connector and the slot in the indicator plate.

C. MULTIPORT ELECTRONIC CONTROLLER SET UP

Refer to the MEC service manual I-0168 for detailed instruction on:

1. Disabling port positions (I-0168 Section I).

2. Controller address (I-0168 Section J).
3. Control room MODBUS RTU operation (I-0168 Section D).
4. Installation and use of Bettis Multiport Electronic Controller software on laptop PC.

IV MULTIPOINT MAINTENANCE

Refer to the typical multipoint assembly drawing AB0461 on page 14 and the multipoint cutaway drawing AB0462 on page 15.

The Multipoint Flow Selector is shipped completely greased and lubricated, but it is recommended that the unit be checked prior to operation if it has been stored for more than one year. If required, lubricate with a suitable injection lubricant (Sealweld D-1014 is recommended).

1. Check speed reducer oil at regular intervals and change the oil each one hundred running hours or once a year, whichever comes first. Use a suitable synthetic gear oil (Mobil Synthetic SHC-634 ISO VG460 lubricant is recommended).
2. Make sure the oil in the speed reducer (426) is at the indicated level.

NOTE: Excessive oil could cause pressure build-up, leakage and overheating which will result in rapid wear of the oil seals, bearing and gears.

3. Lubricate bearing (160) through grease nipple every six months, or as needed. Use Dow Corning Extreme High Temp #41 grease or a suitable equivalent.
4. Do not lubricate the motor: it is a sealed unit.
5. Monitor seals annually, adjusting if required (see section **V-D.** below) and replace seals every five years or when leakage occurs.

V MULTIPOINT ASSEMBLY

Refer to the typical multipoint assembly drawing AB0461 on page 14 and the multipoint cutaway drawing AB0462 on page 15.

Ensure all parts are clean and in good condition before assembling the Multipoint Flow Selector. Use ESSO Valve Grease No. 1 or a suitable equivalent to lubricate the components.

A. BODY: (110)

1. Visually inspect all internal and external surfaces and threads.
2. Lubricate and install the 25% C/PTFE bushing (120) into the lower section of the body.

B. PLUG: (130)

1. Lubricate and install the lower plug o-ring (133), with the correct number of PTFE backup rings (136). For ANSI 300/600 rated Multipoints, install one PTFE backup ring above (on the side nearest to the bonnet) the o-ring. For ANSI 900/1500 rated Multipoints, install two PTFE backup rings - one on either side of the lower plug o-ring.
2. Lubricate and install the seal adjusting nut (138) by turning it clockwise (ie. viewing toward the plug centerline) until solid. Follow with the seal wave springs (140). Ensure that the seal wave springs are properly aligned and seated on the seal adjusting nut.

NOTE:If the seal wave springs are not properly aligned and seated the plug seal may not hold rated differential pressure.

3. Install the seal back-up plate (143) against the shoulder in the plug.
4. Lubricate and install the plug seal o-ring (149) on the stainless steel portion of the plug seal assembly (142). Lubricate and install the plug seal assembly into the plug with the plug seal o-ring properly positioned.

NOTE:Press seal assembly into the plug using hand force only, taking care not to damage seal assembly.

5. Install the correct number of scraper wave springs (158) followed by the scraper (154) into the plug over the seal assembly. For NPS 2" Multiports, install two scraper wave springs. For NPS 3" and NPS 4" Multiports, install one scraper wave spring.

NOTE:Lubricate the spring and scraper so that they stay in place in the plug during assembly. Ensure that the scraper fits freely into the plug. Check by pushing the scraper into the plug using both hands then letting go to see if it returns to its original position.

6. Ensure that the plug bushing (120) has been lubricated and installed into the lower section of the body.
7. Lower the plug (130) vertically into the body ensuring that the plug seal assembly (142) and scraper (154) clear the body (110) bore. When installed, the plug (130) rests on top of the bushing (120).
8. Grease the tapered bearing cone and rollers (160) and install onto the plug.

C. BONNET: (162)

1. Lubricate and press fit the bearing cup (160) into the bonnet.
2. Lubricate and install the correct number of PTFE backup rings (170) and the upper plug o-ring (167) into the bonnet bore's upper groove. For ANSI 300/600 rated Multiports, install one PTFE backup ring above the upper plug o-ring. For ANSI 900/1500 rated Multiports, install two backup rings - one on either side of the upper plug o-ring.
3. Lubricate and install the upper plug polypak (164) into the bonnet (polypak is not required for NPS 2" or NPS 3" ANSI 300/600 Multiports).
4. Lubricate and install the bonnet o-ring (173) into the bonnet's outer groove.
5. From the bonnet's top surface, lubricate and install the wiper (171) and grease fitting (178).

NOTE: Pump grease through the grease fitting (178) to fill the bearing bore.

6. For NPS 3" ANSI 900/1500 and all NPS 4" Multiports, install the injection nipple (177), 90° elbow (175), nipple, ball valve (174) and vent plug (176), ensuring that they are clean and well oiled.
7. Position the bonnet onto the Multiport body. For NPS 2" and NPS 3" ANSI 300/600 Multiports, set the bonnet in place with the actuator mounting holes straddling the centreline of the group outlet port. Use two lifting eyes installed into the jacking screw holes provided in the bonnet for NPS 3" ANSI 900/1500 (3/4 NC) and all NPS 4" (1/2 NC) Multiports to vertically lift and set the

bonnet in place on the multiport body with the seal injection fitting over the group outlet. The bonnet stud holes must be aligned with the body's tapped stud holes.

NOTE: Ensure the bonnet is flat and lowered slowly onto the top of the multiport body in order to prevent damaging the body o-ring and plug seals. Push the bonnet down by hand or rubber mallet only.

8. Install the bonnet studs (180). Use Jet-Lube Kopr-Kote anti-seize lubricant or a suitable equivalent.
9. For NPS 4" ANSI 600/900 and NPS 3" ANSI 900/1500 Multiports, install the two lifting lugs (179) 90° from the group outlet.

NOTE: The actual lifting lug position is 90° from the position shown in the typical assembly drawing on page 8.

10. Tighten two of the bonnet nuts (182) at 180° interval. Then ensure that the plug (130) rotates freely through one revolution.
11. Install and tighten the remaining nuts (182) after confirming that the bonnet (162) and plug (130) have been centred. Torque the nuts to:

MULTIPORT SIZE AND RATING	BONNET NUT TORQUE FT-LBS
NPS 2" ANSI 300/600	100
NPS 3" ANSI 300/600	250
NPS 3" ANSI 900/1500	325
NPS 4" ANSI 600	450
NPS 4" ANSI 900	625

D. PLUG SEAL ADJUSTMENT (162):

1. Adjust the plug seal assembly (142) by aligning the plug (130) with an open (home test) port and turning the adjusting nut (138) counter clockwise with the adjusting tool (viewing toward the plug centerline) until the scraper (154) touches the inside wall surface. As the scraper approaches the wall surface the seal wave springs will be compressed and the adjusting nut will have increased resistance to turning.
2. Rotate the plug (130) at least one complete revolution to check for binding or excessive turning torque. Tighten the seal adjusting nut (138) counter clockwise (viewing towards the plug centerline) to the appropriate torque value with the supplied adjusting tool.

MULTIPORT SIZE AND RATING	PLUG SEAL TORQUE FT-LBS
NPS 2" ANSI 300/600	30
NPS 3" ANSI 300/600	35
NPS 3" ANSI 900/1500	30
NPS 4" ANSI 600	40
NPS 4" ANSI 900	40

NOTE: Do not over tighten the seal adjusting nut (138), as damage to the plug seal assembly may result.

3. Turn the plug (130) at least one complete revolution while checking for smooth movement. If the plug seal assembly (142) is binding at inlet ports when the plug is rotated, the plug seal assembly or the seal wave springs (140) are not in their proper position(s). See disassembly procedure below, if required.
4. Install the two bonnet vent plugs (176).
5. Perform any required leakage test(s).

VI MULTIPOINT DISASSEMBLY

Refer to typical multipoint assembly drawing AB0461 on page 14, and the multipoint cutaway drawing AB0462 on page 15.

NOTE: The bonnet can be removed with the motor and gearbox still attached as one unit. When doing so, place a reference mark on the plug and connector before removal to ensure that they are replaced in the same position when the bonnet, motor, and gearbox are re-installed.

1. Ensure that both the group and test pressures are zero before proceeding.
2. Open a home test port for access to the seal assembly. Turn the seal adjusting nut (138) clockwise until solid (viewing toward plug centerline) in order to release the spring load from the plug seal assembly and provide clearance for the scraper in the body.
3. Remove the bonnet nuts (182) and studs (180). Lift the bonnet vertically until it is clear of the plug and body. Lifting eyes can be installed in the jacking screw holes provided in the bonnet for some NPS 3" (3/4" NC) and NPS 4" (1/2" NC) Multipoints. Set the bonnet aside.
4. Remove the plug (130), complete with all seal components, from the multipoint body.
5. Disassemble the plug and plug seal and inspect all components. Reassemble following Multipoint Assembly procedure. The seal can be removed using the adjusting tool as follows:
 - i) Insert the tool into the seal adjusting nut and turn it counterclockwise until it disengages from the final thread on the plug/rotor body.
 - ii) Use the tool as a slide hammer on the back of the seal adjusting nut to pull the seal assembly out of the plug/rotor body.
6. Removal of the bearing cup from the bonnet may require the use of a square stem puller and/or dry ice (to shrink and loosen the bearing cup).

VII ACTUATOR ASSEMBLY

A. Pedestal, Connector, Speed Reducer, and Motor

Refer to typical assembly drawing AB0461 on page 14 and the typical controller assembly drawing AB0463 on page 16.

1. Set the speed reducer pedestal (400) in place. Align motor for correct orientation.
2. Install two bolts (404), two lockwashers (406), two spacers (401), two studs (403), and four nuts (405) with the indicator plate (402). The two bolts must be installed opposite each other (180° apart) so that the indicator plate can be mounted on the studs and spacers.
3. Install the lower connector (408).

NOTE: An index mark on one flat on the square end of the plug (130) indicates port position. Install the connector so that the index mark is visible.

4. Install the indicator (188) on the upper connector (410) using the nut (192). Ensure that the indicator is aligned with the index mark on the square end of the plug.
5. Place the upper connector (410) on the lower connector with the setscrew (413) started but without the connector bolt and locknut.
6. Install the speed reducer (426) onto the pedestal with the key (418) and four bolts (432), lockwashers (436), and nuts (434).
7. Install the motor (438) onto the speed reducer with four bolts and lockwashers. Ensure that the key is in place before aligning and tightening the motor mounting bolts (refer to motor and gear reducer product info for specific installation and maintenance instructions).
8. Check for free rotation between the connector halves to confirm shaft alignment. This can be done by turning the gear reducer by hand (or by using the electric motor) with the connector parts and bolts loosely installed. Adjust the position of the connector halves if necessary.

NOTE: Use caution and keep hands away from all rotating parts if operating the electric motor to check alignment.

9. Tighten all mounting bolts and nuts
10. Install and tighten the lower connector bolt and locknut and tighten the setscrew (413).

B. Local Stepping Command Electrical Conduit, Switchpak Pedestal, and Connector

Refer to the typical electrical assembly drawing AB0463 on page 16. Note that the assembly details may vary according to local regulations (i.e. use of cable instead of conduit).

1. Set the Switchpak pedestal (448) on top of the speed reducer body and install four studs (452), four lockwashers (453) and four nuts (454).
- 2.
3. Install the Switchpak connector (457) on the speed reducer shaft followed by the Switchpak coupling (455) and the Switchpak coupling adapter (459).
4. Install the Switchpak (300) onto the Switchpak pedestal.
5. Install the four Switchpak bolts (458) and lockwashers (462).
6. Off the Switchpak pedestal assemble the push button station (350), local/remote switch (357), and jog push button (356). Loosely install the push button station bolt (351), lockwasher (354), and nut (352). If required, use the spacer (358) to fill the gap between the pushbutton station and the Switchpak pedestal.
7. Install all wiring, conduit, and seals according to the electrical diagram and local regulations.
8. With connector parts loosely installed, rotate the shaft (either by hand or using the motor) and check for proper alignment of the connector halves. Adjust if any binding is detected.
9. Tighten all mounting bolts, nuts, and setscrews.

NOTE: Ensure that the connector setscrew seats against the flat section of the Switchpak shaft.

VIII TROUBLESHOOTING

A. Actuator Does Not Align Plug (130) to Port.

1. Check the multiport/actuator connector for looseness.
2. Check the Switchpak/actuator connector for looseness.
3. Check the motor for stalling or overload.
4. Check the speed reducer for visual leakage or noisy gear.
5. Check the accuracy of the position encoder itself (see manual RD-00232, "MultiPort Electronic Controller with MP-800 Board).
6. Refer to the Multiport Electronic Controller service manual (RD-00232) for port calibration procedures.

B. Plug Seal Assembly Leaks.

1. Refer to specification for rated differential pressure limitations.
2. Check the indicator plate and pin to ensure that the plug is aligned with the port .
3. Check the seal for damage (CAUTION: Ensure that all pressures in the Multiport body, group outlet, and test port are ZERO before visually checking the seal). With the multiport selector and piping at zero pressure, remove the test port blind flange and visually check for plug seal assembly damage (ie. Scratches) as the plug seal passes the test port .
4. If more information is required contact the factory.

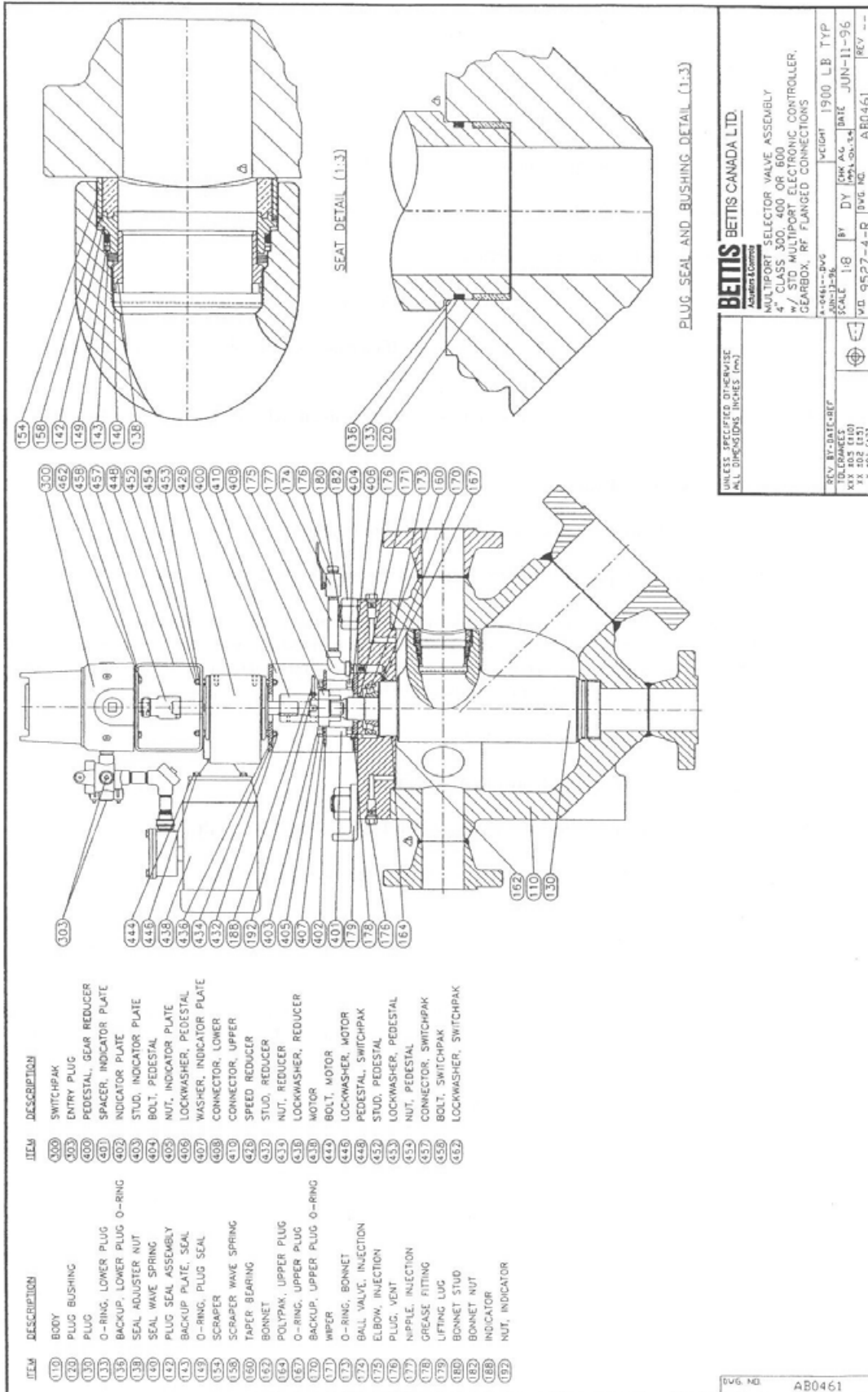
C. Plug to Bonnet Stem Seal Leaks to Atmosphere.

NOTE: This section applies to NPS 3" ANSI 900/1500 and NPS 4" Multiports only.

Refer to the injection system drawing I-0240 on page 18. Recommended sealant is Sealweld D-1014 or equivalent.

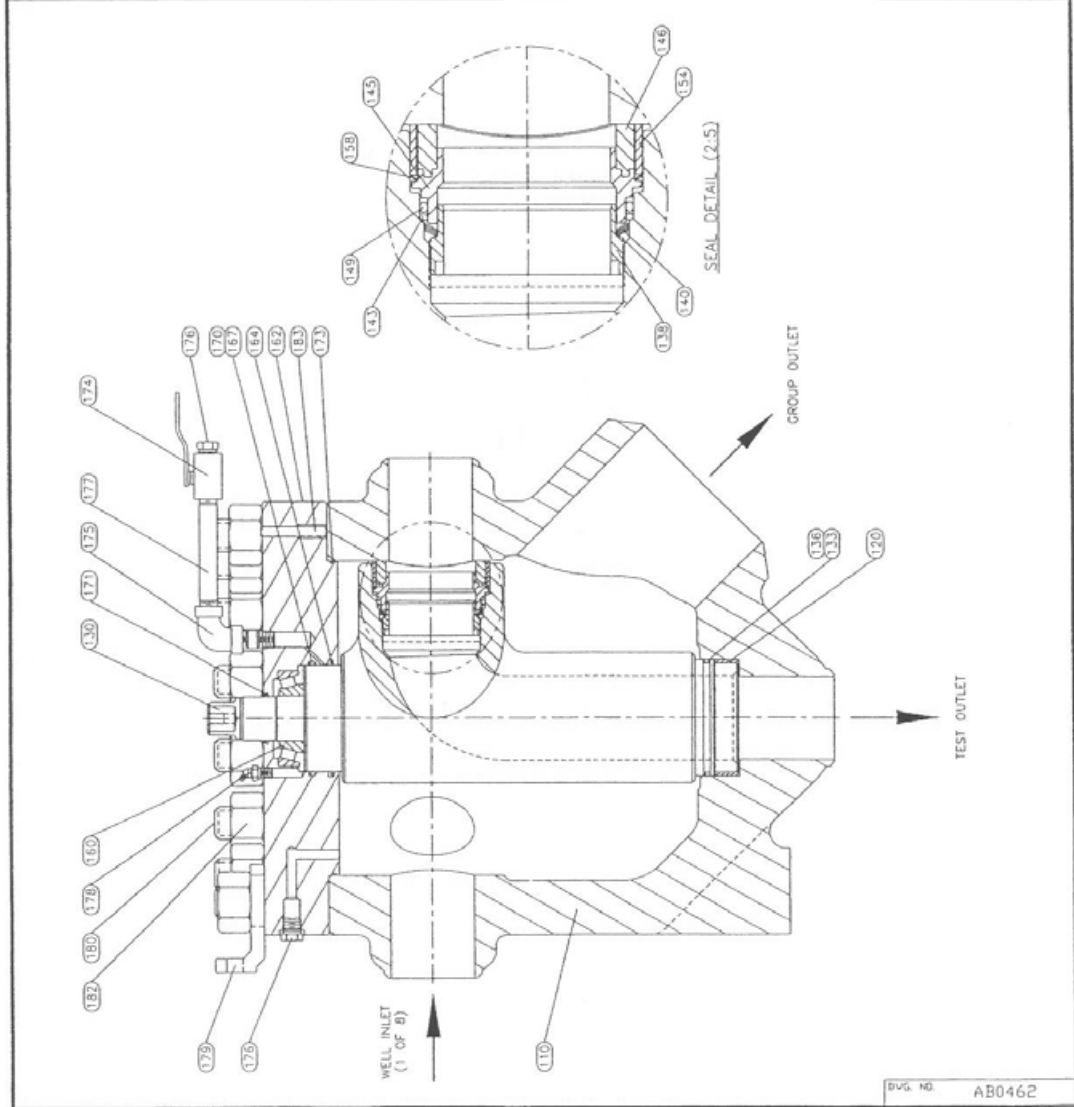
1. The Multiport Flow Selector is shipped with the service valve (174) in the normally closed position.
2. To determine if the primary seal has failed, remove the vent plug (176) from the service valve and gradually open it. Any leakage occurring past the primary seal will drain out of the open service valve.
3. If more information is required, contact the factory.

IX DRAWINGS



ITEM	DESCRIPTION	MATERIAL	QTY	NOTE
110	BODY	A216-WCB	1	
120	PLUG BUSHING	25% CARBON TEFLON	1	(Y)
130	PLUG	A536 GR 65-45-12	1	(A,Y)
133	O-RING, LOWER PLUG	AFLAS	1	(Y)
136	O-RING BACKUP	TEFLON	1	(Y)
138	SEAL ADJUSTER NUT	17-4 PH	1	
140	WAVE SPRING, SEAL	SS 302	4	
143	BACKUP PLATE	17-4 PH	1	(Y)
145	SEAT RING	25% CARBON TEFLON	1	(A,Y)
146	SEAL INSERT	AFLAS	1	(A,Y)
149	O-RING, PLUG SEAL	17-4 PH	1	
154	SCRAPER	SS 302	1	
158	WAVE SPRING, SCRAPER	TIMKEN	1	
160	TAPER BEARING	A516-70	1	(Y)
162	BONNET	TEFLON	1	(A,Y)
164	POLYPAK, UPPER PLUG	CARBONYL	1	(Y)
167	O-RING, UPPER PLUG	AFLAS	1	(A,Y)
170	O-RING BACKUP	TEFLON	1	(Y)
171	WIPER	AFLAS	1	(A,Y)
173	O-RING, BONNET	A105N	1	
174	BALL VALVE, INJECTION	A105N	1	
175	ELBOW, 90° INJECTION	A105-ZN PL	3	
176	PLUG, TEST/INJECTION	A106-B X5	2	
177	INPLEE, INJECTION	CS ZN PL	1	
178	GREASE FITTING	308W	2	
179	LIFTING LUG	GR B7M	16	
180	BONNET STUD	GR ZHM	16	
182	BONNET NUT	GR B ZN PL	16	
183	BONNET JACKSCREW	GR B ZN PL	2	

NOTE:
 (A) ALTERNATIVE MATERIAL MAY BE SPECIFIED
 (Y) RECOMMENDED SPARE PARTS/REPAIR KIT



BETTS
 Actuators & Controls

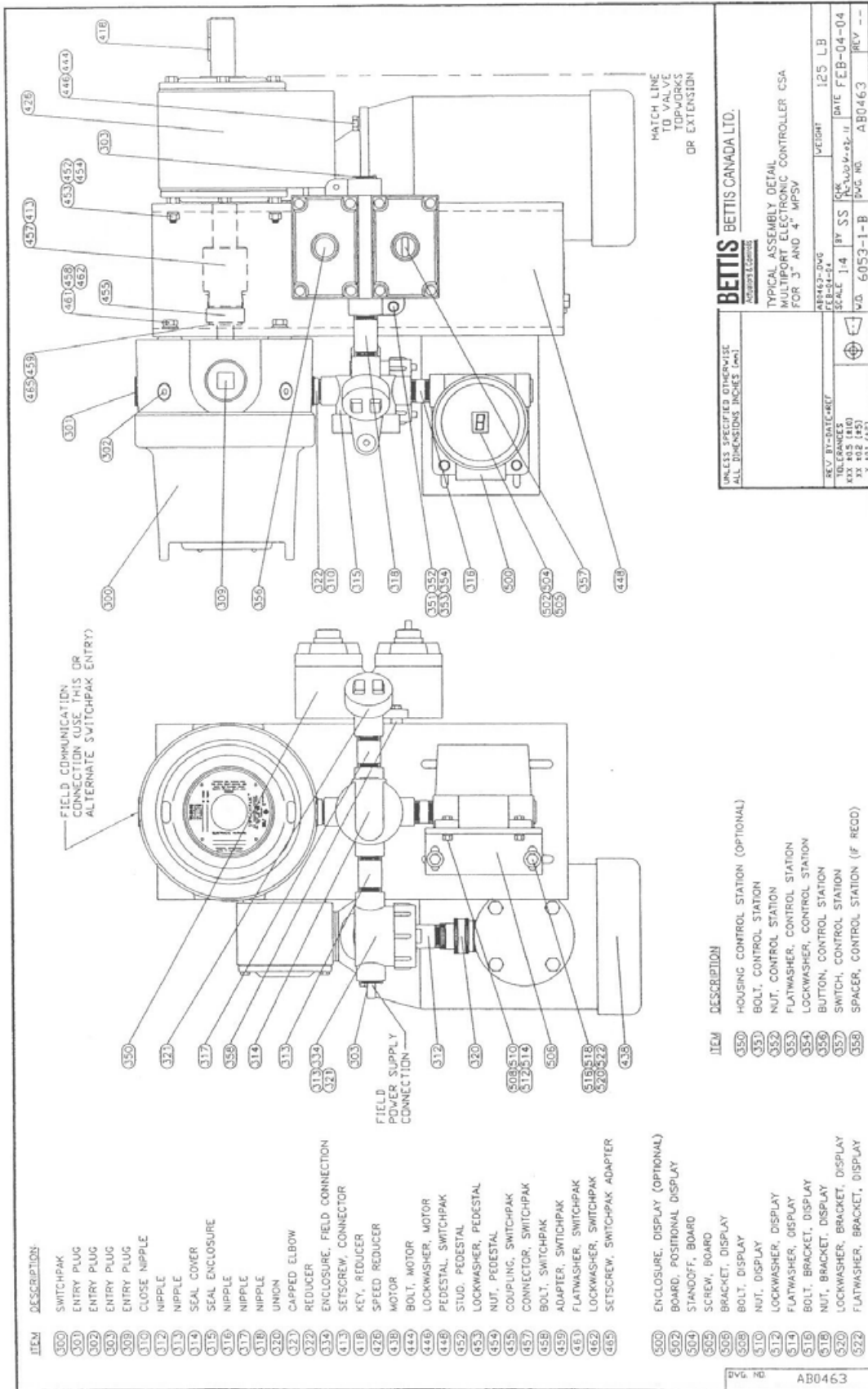
PROCESS SPECIFIED OTHERWISE
 ALL DIMENSIONS INCHES (mm)

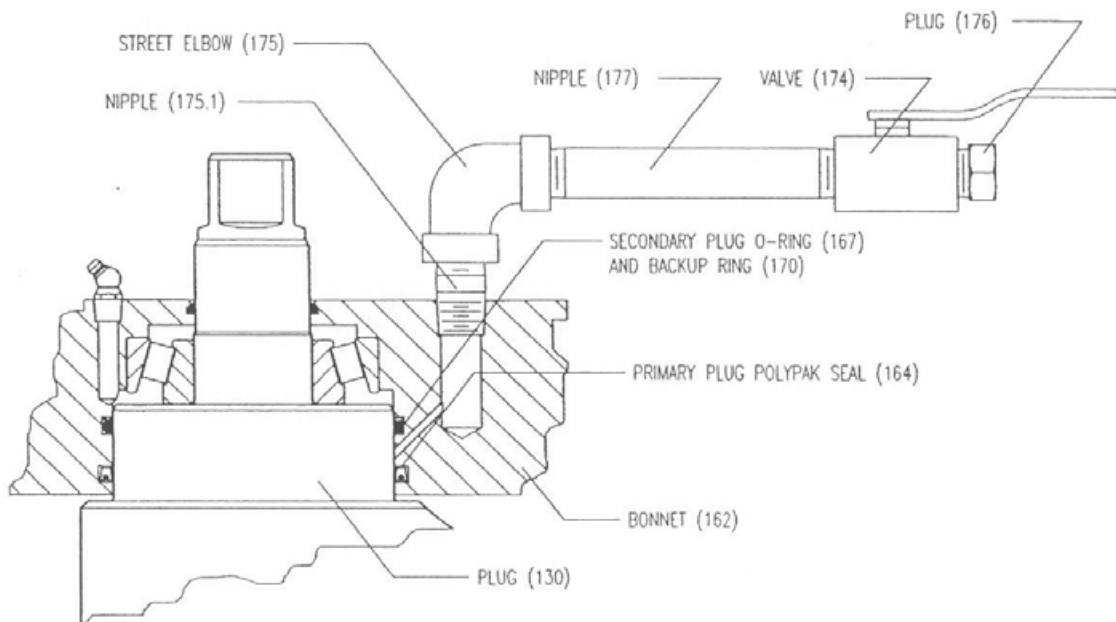
MULTI-PORT SELECTOR VALVE
 TYPICAL ASSEMBLY FOR NPS 4 X NPS B
 W/ HIGH PRESSURE DIFFERENTIAL SEAL

REV. BY DATE REF
 155 1-5
 TOLERANCES
 XXX .005 (±.01)
 XX .010 (±.02)
 X .015 (±.03)

WEIGHT 1900 LB
 DATE JUL-17-00
 V.D. 186601-1-C
 S/C NO. AB0462

FIG. NO. AB0462





NOTE:

- 1) TWO PLUG SEALS ARE PROVIDED, AN UPPER O-RING (167) WITH A BACKUP RING (170) AND A LOWER POLYPAK (164)
- 2) UNDER NORMAL OPERATING CONDITIONS THE SERVICE VALVE (174) IS CLOSED AND THE PRIMARY POLYPAK SEAL (164) PRODUCES A SEAL.
- 3) A FIELD OPERATOR, AS REQUIRED, MAY CHECK THE PRIMARY POLYPAK SEAL (164) BY REMOVING THE VENT PLUG (176) AND OPENING THE SERVICE VALVE (174).
- 4) IF THE PRIMARY POLYPAK SEAL (164) HAS FAILED, STEM LEAKAGE WILL BE VENTED THROUGH THE OPENED SERVICE VALVE (174). WITH THE SERVICE VALVE (174) CLOSED, THE SECONDARY O-RING (167) BECOMES ENERGIZED IF THE PRIMARY SEAL (174) HAS FAILED.
- 5) IN AN EMERGENCY SITUATION, WHERE BOTH PLUG SEALS HAVE FAILED, A TEMPORARY SEAL MAY BE CREATED BY INJECTING SEALANT INTO THE EMPTY SPACE BETWEEN THE TWO PLUG SEALS (167) AND (164). TO CREATE THE TEMPORARY SEAL, CLOSE THE SERVICE VALVE (174), REMOVE THE VENT PLUG (176) AND INSTALL A SUITABLE BUTTOMHEAD FITTING ONTO THE SERVICE VALVE. THEN OPEN THE SERVICE VALVE (174) AND INJECT THE SEALANT, INTO THE BONNET, UNTIL A SEAL IS CREATED.

UNLESS SPECIFIED OTHERWISE ALL DIMENSIONS INCHES [mm]		BETTIS BETTIS CANADA LTD. <i>Actuators & Controls</i> <i>A Daviel Industries Company</i>	
ADD 3 X 6 CLASS 1500 △RB-1999-01-25 @ 07478-1-R		INJECTION SYSTEM OPERATION MULTIPORT SELECTOR VALVE NPS 4X8 CLASS 600, NPS 3X6 CLASS 1500	
REV BY-DATE+REF		AB0460--DWG_VIEW_I-0240 JAN-25-99	
TOLERANCES XXX ±0.5 [±10] XX ±0.2 [±5] X ±0.1 [±2]		SCALE 1:3 BY RB	CHK DATE AUG-25-98 A-1999-01-26
		W.D. 14548-1-R	DWG. NO. I-0240 REV 1-

X **TYPICAL MULTIPOINT SEAL COMPONENTS**



PLUG SEAL COMPONENTS



SEAL ASSEMBLY (L→R: BACKUP PLATE, O-RING, SEAT RING, SEAL INSERT, ASSEMBLY)



SEAL ASSEMBLY (TOP: ASSEMBLY. BOTTOM (L→R): SEAL ADJUSTMENT NUT, SEAL WAVE SPRINGS, SEAT RING/PLATE/O-RING/SEAL INSERT, SCRAPER WAVE SPRINGS, SCRAPER)



PLUG SEAL ADJUSTMENT TOOL SHOWN WITH BASE PARALLEL TO SHANK FOR INSERTION, BASE PERPENDICULAR TO SHANK, AND ENGAGED IN SEAL ADJUSTMENT NUT.



PLUG (Index mark can be found on the stem flat that faces the same way as the plug seal opening.)



PLUG SEAL ADJUSTMENT TOOL IN PLUG

APPENDIX 1: MOTORS

A: Baldor Motors



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AC & DC Motor Installation – Maintenance Instructions

These instructions are intended to complement (not replace) the information in MN400 Installation and Operation manual for "Integral Horsepower AC Induction Motors ODP, TEFC, Explosion Proof" and MN605 Installation and Operation manual for "Integral Horsepower DC Motors".

Handling

The weight of the motor and shipping container will vary. Use correct material handling equipment to avoid injury.

Use caution when removing the motor from its packaging. Sharp corners may exist on motor shaft, motor key, sheet metal and other surfaces.

Receiving

Inspect the motor for damage before accepting it. The Motor shaft should rotate freely with no rubs. Report any damage immediately to the commercial carrier that delivered your motor.

Safety Notice

Only qualified personnel trained in the safe installation and operation of this equipment should install this motor. When improperly installed or used, rotating equipment can cause serious or fatal injury. Equipment must be installed in accordance with the National Electrical Code (NEC), local codes and NEMA MG2 Safety Standards for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators. Observe the following guidelines:

1. When eyebolts are provided, they must be fully tightened and are intended to lift the motor and its included accessories only.
2. Ground the motor according to NEC and local codes.
3. Provide a permanent guard to prevent accidental contact of body parts or clothing with rotating or moving parts or burns if motor is hot.
4. Shaft key must be secured before starting motor.
5. Do not apply power to the motor until the motor is securely mounted by its mounting holes.
6. This motor must only be connected to the proper line voltage, line frequency and load size.
7. Motors are not to be used for load holding or restraining unless a properly sized brake is installed. If a motor mounted brake is installed, provide proper safeguards for personnel in case of brake failure.
8. Disconnect all power services, stop the motor and allow it to cool before servicing.
9. For single phase motors, discharge the start and/or run capacitors before servicing.
10. Do not by-pass or render inoperative any safety device.
11. DC series wound motors must be protected from sudden loss of load causing overspeed damage. DC shunt wound motors must be protected from loss of field voltage which can result in damage.
12. When using AC motors with frequency inverters, be certain that the motors Maximum Speed Rating is not exceeded.
13. Mounting bolts should be high tensile steel. Be sure to use a suitable locking device on each bolt (spring washer or thread lock compound).

Guarding

After motor installation is complete, a guard of suitable dimensions must be constructed and installed around the motor/gearmotor.

This guard must prevent personnel from coming in contact with any moving parts of the motor or drive assembly but must allow sufficient cooling air to pass over the motor.

If a motor mounted brake is installed, provide proper safeguards for personnel in case of brake failure.

Brush inspection plates and electrical connection cover plates or lids, must be installed before operating the motor.

When this motor is installed according to these instructions, it complies with the EEC Machinery Directive. Electromagnetic Compatibility (EMC) requirements for CE compliance are met when the incoming power is purely sinusoidal. For other power source types, refer to MN1363 "Recommended Practices for Installation for EC Directive 89/336/EEC Relating to EMC".

Motor Enclosure

ODP, **Open drip proof** motors are intended for use in clean, dry locations with adequate supply of cooling air. These motors should not be used in the presence of flammable or combustible materials. Open motors can emit flame and/or molten metal in the event of insulation failure. TEFC, **totally enclosed** motors are intended for use where moisture, dirt and/or corrosive materials are present in indoor and outdoor locations.

Explosion proof motors, as indicated by the Underwriters Laboratories, Inc. label are intended for use in hazardous areas as specified by the NEC.

Mounting

Foot mounted machines should be mounted to a rigid foundation to prevent excessive vibration. Shims may be used if location is uneven.

Flange mounted machines should be properly seated and aligned. Note: If improper rotation direction is detrimental to the load, check rotation direction prior to coupling the load to the motor shaft.

For **V-belt drive**, mount the sheave pulley close to the motor housing. Allow clearance for end to end movement of the motor shaft. Do not overtighten belts as this may cause premature bearing failure or shaft breakage.

Direct coupled machines should be carefully aligned and the shaft should rotate freely without binding.

Wiring

Connect the motor as shown in the connection diagram. If this motor is installed as part of a motor control drive system, connect and protect the motor according to the control manufacturers diagrams. The wiring, fusing and grounding must comply with the National Electrical Code and local codes. When the motor is connected to the load for proper direction of rotation and started, it should start quickly and run smoothly. If not, stop the motor immediately and determine the cause. Possible causes are: low voltage at the motor, motor connections are not correct or the load is too heavy. Check the motor current after a few minutes of operation and compare the measured current with the nameplate rating.

Adjustment

The neutral is adjustable on some DC motors. AC motors have no adjustable parts.

Noise

For specific sound power or pressure level information, contact your local Baldor representative.

Vibration

This motor is balanced to NEMA MG1, Part 7 standard.

Brushes (DC Motors)

Periodically, the brushes should be inspected and all brush dust blown out of the motor. If a brush is worn $\frac{1}{2}$ " (from length specified in renewal parts data), replace the brushes. If the commutator is worn or rough, the armature should be removed. The commutator should be turned in a lathe, the mica recut and the commutator polished. Reassemble and seat the new brushes using a brush seating stone. Be sure the rocker arm is set on the neutral mark.

Lubrication

This is a ball or roller bearing motor. The bearings have been lubricated at the factory. Motors that do not have regrease capability are factory lubricated for the normal life of the bearings.

Lubricant

Baldor motors are pregreased, normally with Polyrex EM (Exxon Mobil). If other greases are preferred, check with a local Baldor Service Center for recommendations.

Relubrication Intervals (For motors with regrease capability)

New motors that have been stored for a year or more should be relubricated. Lubrication is also recommended at these intervals:

Table 1 Relubrication Interval

NEMA (IEC) Frame Size	Rated Speed (RPM)			
	3600	1800	1200	900
Up to 210 incl. (132)	5500Hrs.	12000Hrs.	18000Hrs.	22000Hrs.
Over 210 to 280 incl. (180)	3600Hrs.	9500Hrs.	15000Hrs.	18000Hrs.
Over 280 to 360 incl. (225)	*2200Hrs.	7400Hrs.	12000Hrs.	15000Hrs.
Over 360 to 5000 incl.(300)	*2200Hrs.	3500Hrs.	7400Hrs.	10500Hrs.

* Lubrication interval for 6313 or 6314 bearings that are used in 360 through 5000 frame, 2 pole motors. If roller bearings are used, bearings must be lubricated more frequently, divide the relubrication interval by 2.

Table 2 Service Conditions

Severity of Service	Ambient Temperature Maximum	Atmospheric Contamination	Type of Bearing
Standard	40° C	Clean, Little Corrosion	Deep Groove Ball Bearing
Severe	50° C	Moderate dirt, Corrosion	Ball Thrust, Roller
Extreme	>50° C* or Class H Insulation	Severe dirt, Abrasive dust, Corrosion	All Bearings
Low Temperature	<-30° C**		

* Special high temperature grease is recommended.

** Special low temperature grease is recommended.

Table 3 Lubrication Interval Multiplier

Severity of Service	Multiplier
Standard	1.0
Severe	0.5
Extreme	0.1
Low Temperature	1.0

Table 4 Amount of Grease to Add

Frame Size NEMA (IEC)	Bearing Description (Largest bearing in each frame size)					
	Bearing	OD D mm	Width B mm	Weight of grease to add ounce (gram)	Volume of grease to add	
					inches ³	teaspoon
Up to 210 incl. (132)	6307	80	21	0.30 (8.4)	0.6	2.0
Over 210 to 280 incl. (180)	6311	120	29	0.61 (17.4)	1.2	3.9
Over 280 to 360 incl. (225)	6313	140	33	0.81 (23.1)	1.5	5.2
Over 360 to 5000 incl. (300)	NU322	240	50	2.12 (60.0)	4.1	13.4

Weight in grams = 0.005 DB

Procedure

Clean the grease fitting (or area around grease hole, if equipped with slotted grease screws). If motor has a purge plug, remove it. Motors can be regreased while stopped (at less than 80°C) or running.

Apply grease gun to fitting (or grease hole). Too much grease or injecting grease too quickly can cause premature bearing failure. Slowly apply the recommended amount of grease, taking 1 minute or so to apply. Operate motor for 20 minutes, reinstall purge plug if previously removed.

Caution: Keep grease clean. Mixing dissimilar grease is not recommended.

Sample Relubrication Determination

This sample determination is based on a NEMA 286T (IEC 180) motor operating at 1750 RPM driving an exhaust fan in an ambient of 43°C atmosphere that is moderately corrosive.

1. Table 1 list 9500 hours for standard conditions.
2. Table 2 classifies severity of service as "Severe".
3. Table 3 lists a multiplier value of 0.5 for Severe conditions.
4. Table 4 shows that 1.2 in³ or 3.9 teaspoon of grease is to be added.

Note: Smaller bearings in size category may require reduced amounts of grease.



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2/03

LB5040

INSTRUCTIONS MANUAL: EXPLOSION PROOF MOTORS

INTRODUCTION

An explosion-proof, and in particular a flameproof motor, is one that is inherently safe when working in potentially explosive atmospheres.

This means that its construction and assembly are designed so that ingress of explosive gases is rendered harmless for the environment.

In the event of accidental ignition, provoking an explosion inside the motor housing, the motor shell and brackets are strong enough to resist the internal pressure created by this explosion.

Moreover, assembly joints and shaft clearance must be long enough and offer minimum play, so that hot gases resulting from an explosion will be cooled sufficiently to create no possibility of an explosion outside the motor.

The outside temperature of the motor enclosure must also be kept well below the flash point of the gases present in the hazardous atmosphere, both in normal and abnormal working conditions.

Finally, it is the manufacturer's concern that components inside the motor should be able to withstand an occasional explosion without being adversely affected.

The degree of risk is dependant on the constituents of the hazardous atmosphere: even combustible dust can become explosive when spread in the air in the right proportion.

Therefore, existing risks have been divided into categories, depending on the temperature at which the gas or vapour mixtures become flammable, and also on their explosive energy.

For each of these, specific safety rules have been evolved on a European level.

Compliance with these rules is verified by an Ex notified body, approved for certification in accordance with article 9 of the European Community Council directive, no 94/9/CEE of 23 march 1994.

Certification delivered by any of the notified bodies is automatically valid in all CEE countries. It is recognised by all European adherent countries and also very seriously considered in many countries overseas, U.S.A. included.

In Belgium, it is the "Institut Scientifique de Service Public", in short ISSeP, which has been chosen for its long experience in problems of safety in mining industries.

As explosion proof motors are constructed with special materials and technologies that comply with the legal regulations concerning potentially explosive atmospheres, a wrong connection or a minor modification of the motor destroys the compliance with security regulations. The rules concerning explosion proof apparatus must be observed unconditionally. Note that our motors are approved for a specific group of hazardous areas and temperature classes.

USE OF EExd MOTORS

The user is responsible for the choice of the type of explosion proof motor. He has to take into account the explosion risks area in which the motor will run (classification of hazardous areas, temperature class,...).

Before installation, the user has to check if the group and protection class, marked on the motor label, corresponds with the requested conditions.

INCOMING INSPECTION

Inspect the motor to detect any signs of damage during the transport.

Check that the motor nameplate data complies with your order or specification. In the unlikely event of a claim, please contact our Sales Office.

STORAGE

The motor should be stored in a clean, dry and vibrations free environment. . If the motor is to be stored for a long period of time, the machined surfaces protected with anti-rust coating should be checked and "touched up" if necessary.

If the motor is fitted with anti-condensation heaters, these should be connected during the storage period.

MOUNTING AND START UP

Electric data of the motor, valid for the rated power, can be found on the nameplate.

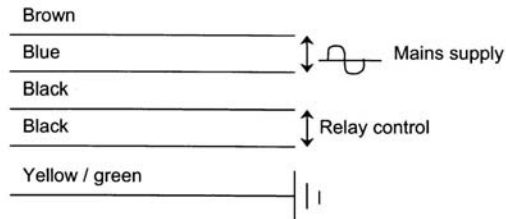
It is the responsibility of the user to ensure that the motor nameplate voltage and frequency are the same as the mains supply.

Connection to the mains supply should only be executed by a recognised professional, respecting local demands and regulations.

The user must ensure that the diameter of the cable is adequate for the voltage and current involved. (See nameplate data of motor)

The connection of the wires must be done as described in the connection diagram that is delivered with the motor. The connection diagram is usually located inside the cover of the terminal box. If the motor does not have a terminal box, it is located on the housing or attached to the cable.

The connection diagram is structured as follows: (see example)



The leads can be coloured or numbered. Each line represents one lead. The given connection diagram is an example only.

The motor must be protected against overloads and short-circuits.

When installing the motor, always connect the earth, using the earthing screw in the terminal box or on the motor frame. Always check local regulations and demands.

The manufacturer cannot be held responsible for damage due to incorrect installation or use.

Free circulation of fresh air for cooling the motor must be guaranteed.

The maximum ambient temperature must not exceed the given value that is indicated on the nameplate and in the motor certificate.

To guarantee the explosion proof protection, certified explosion proof cable glands with sealing joints adapted to the cable diameters, must be used.

THE MOTOR WILL LOSE ITS EXPLOSION PROOF CHARACTERISTICS IF THE CABLE AND GLANDS ARE NOT FITTED CORRECTLY!

Note: If a spare opening for a cable gland isn't used, only the use of a certified explosion proof plug retains the explosion proof characteristics.

Particular attention is to be given to the fixing torque of bolts and screws. The motor fixing bolts are factory mounted with the correct torque and should not be touched.

It may be necessary to open the terminal box for connecting the motor. When re-mounting the cover, only use the original screws. In order to prevent damage to the motor components, never apply the maximum permissible torque for the applied bolts and nuts.

IMPORTANT: Firstly tighten all screws by hand before applying the full torque. Then tighten the screws until the spring ring is flat.

Using a pulley or a coupling device:

Apply only well balanced discs and couplings. Check the alignment after assembling. Take care while mounting of the pulley on the shaft: Hammering on the shaft will damage the motor bearings. Pulleys should only be mounted with appropriate mounting tools that do not stress the motor bearings.

Following these recommendations will greatly increase the expected motor bearing life. Safety regulations in respect of guarding couplings and belts from being accidentally touched must be applied.

Use of a frequency converter:

In areas with an explosion risk, the use of the motor over a frequency converter is limited. The frequency converter must in such case be placed outside the explosion-endangered area. If the frequency converter needs to be placed inside the explosion-endangered area, the additional requirements for such an installation must be respected. It should be verified that the functioning of the motor is not influenced in a way that the requirements for Ex-environments are no longer satisfied. Check the corresponding motor Ex certificate for info on this subject.

MOTOR PROTECTION

If the motor is equipped with an automatic reset thermal protection, the motor will in case of thermal cutout restart automatically and without warning after a certain cooling period. Contact the manufacturer if you need more information on the type of protection that is used.

If the motor is supplied with a thermal protection that is brought out separately, the user must connect the protection in a way that the motor is switched off when the protector switches.

MAINTENANCE

The maintenance of the motor can be limited to periodic inspection of the ventilation circuit, to keep it conveniently unobstructed, and to the replacement of the bearings if needed; this period depends on the working conditions and ambient. Re-greasing is not necessary, the ball bearing are lubricated for life.

In the case of DC motors with brushes in continuous contact with the slip rings, the slip rings, the brushes and the brush-holders should be periodically cleaned by vacuum cleaning.

REPAIR

The explosion proof motor must not be opened while the motor is energised, or in the presence of danger of explosions.

Qualified persons only may do repair or service of the motor. If the customer himself carries out the operation, he must observe the valid standards. If a repairer treats the motor, he has to hand a certificate of conformity to the user.

The manufacturer is not responsible for motors that are modified without his written agreement.

SPARE PARTS

Only use original components for the repair of defect components.
For each order of spare parts, the type and number of the motor must be given; these data are indicated on the nameplate.

WARRANTY

Warranty matters are treated in accordance with our general conditions of sale, that are valid at the time of delivery.

MARKING OF ATEX CERTIFIED MOTORS

The motor marking contains the following information with regards to the Ex protection:

CE xxxx Ex II 2 G/D IISeP 01 ATEX yyy X EExd II B T4

- CE CE marking
- xxxx ID of notified body responsible for surveillance
- Ex Community mark for explosion proof equipment
- II Field of application (Group II includes all fields of application except mining)
- 2 Category of protection: For group II: 3 (Normal), 2 (High level) or 1 (Very high level)
- G/D Gas and/or dust hazardous locations (G, D, G/D)

- IISeP Notified body
- 01 Year of emission (2001, 2002, 2003, ...)
- ATEX ATEX directive
- yyy Consecutive number of the year
- X Special conditions for safe use (if any)
- EExd Type of protection (flameproof)
- II Group of equipment
- B Gas group (the classification of gases into groups is described in the standard EN50014)
- T4 Temperature classification (T3 to T6, see table below)

Temperature Class (Group II)	T3	T4	T5	T6
Maximum surface temperature	200°C	135°C	100°C	85°C

The maximum surface temperature of equipment must always be lower than the ignition temperature of the gas present in the hazardous area.

SAFETY CONSIDERATIONS

During normal use, the motor may get hot. (See above table of surface temperatures.)
Precautions may be needed to avoid the risk of burns.

The motor shaft turns at the speed that is indicated on the nameplate, and is potentially dangerous. Precautions may be needed to ensure safe use.

In general, the relevant safety prescriptions for machined must be respected.

MANUFACTURER INFORMATION:

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This document has been made with the greatest care. It is meant as a general guideline and it is not meant to be complete. This document is subject to alterations, check the library section of our website for the most recent version. Always follow relevant local and international regulations and guidelines.

PERMANENT MAGNET DC MOTORS

INSTALLATION, TROUBLESHOOTING & MAINTENANCE BULLETIN



Scope

This bulletin is a guideline for the installation, troubleshooting, and maintenance of the most widely used Pacific Scientific PMDC motors. This bulletin covers motors rated up to and including three horsepower.

Nameplate Data

The motor nameplate provides the operational specifications of the motor. The beginning letter designations of the catalog listing describe the motor type. Designations are as follows:

- SR or SRF. A motor operated by a full wave rectified, 1.4 form factor maximum, SCR control that supplies 90 or 180 volts to the motor.
- PWM or PWMF. A motor operated by a filtered pulsewidth modulated (PWM) control that nominally supplies 130 or 240 volts to the motor.
- BA or BAF. A motor operated by a battery or a low voltage control that typically supplies 12, 24 or 36 volts to the motor.
- EP. These motors are similar in operation to the SR and BA model types, except they are built in an explosion proof housing. While the physical construction of an EP motor is special, all the technical information contained in this bulletin is applicable to these motors.
Caution:
 1. All repairs requiring disassembly of an EP motor must be performed at a UL accepted service facility or Pacific Scientific.
 2. The explosion proof enclosure is not sealed-tight construction. Explosion proof motors should not be used in applications where hose down is necessary. The ST (sealed-tight) series described below is designed for this purpose.
- ST, STF or STC. These motors are similar in operation to the SR and BA model types, except they are built in a sealed tight configuration. While the physical construction of a ST motor is special, all the technical information contained in this bulletin is applicable to these motors.

Additional data typically given on the nameplate includes, armature voltage, full load current, rated horsepower, RPM at rated load, insulation class, and duty rating.

Installation Precautions

- To prevent damage to the motor, insure that it is sized properly for the application. Excessive current draw, above the rating stated on the nameplate, may cause overheating of the motor.
- SR, PWM, and 90 or 180 Vdc ST and EP motors should be protected with a circuit breaker set at 90 to 100 percent of rated nameplate current.
- Inspect the motor installation to insure the load is free to move, and that the area around the motor is clear to allow good ventilation.
- PMDC motors typically run in a clockwise direction (as viewed from the shaft end of the motor) with a positive voltage connected to the A1 terminal of the motor and the negative connected to A2. To reverse the direction of rotation, reverse the connections at A1 and A2.
- Some motors may be equipped with internal thermal overload protection. The thermal overload device is connected via lead wires or rear endbell terminal connections depending on the motor configuration. The thermal overload device is not designed to handle motor current. They are designed for pilot duty only and must be interlocked with an external relay.
- Silicone vapors around PMDC motors will cause rapid brush wear. Avoid Silicone vapors to ensure adequate PMDC motor performance. Sources of Silicone vapors are: RTV, oils, mold release agents and varnishes.
- Always follow local and national electrical and safety codes when installing the motor.
- Normal motor exterior operating temperatures may cause burns. Use caution when touching the exterior of the motor.



Troubleshooting

Performance problems may result from something as simple as worn brushes or as complex as improper sizing or controller failure. Use the following chart as a guide to return the motor to service:

SYMPTOM	POSSIBLE CAUSE	CORRECTIVE ACTION	PROCEDURE
Won't run	<ul style="list-style-type: none"> • Worn brushes • Loose power leads • Brush hung up • Open armature 	<ul style="list-style-type: none"> • Replace brushes • Check wiring • Check brushes • Replace armature 	<ul style="list-style-type: none"> • See Brush Replacement • Tighten leads • Free brush • Contact repair facility
Runs in wrong direction	<ul style="list-style-type: none"> • Power leads reversed 	<ul style="list-style-type: none"> • Check lead polarity 	<ul style="list-style-type: none"> • Reconnect leads
Runs slow	<ul style="list-style-type: none"> • Controller overcurrent adjustment incorrect 	<ul style="list-style-type: none"> • Adjust current limit 	<ul style="list-style-type: none"> • Consult controller literature or contact controller supplier
Runs fast (no-load speed more than 15% higher)	<ul style="list-style-type: none"> • Possible over-current damage or open armature 	<ul style="list-style-type: none"> • Motor may require major overhaul 	<ul style="list-style-type: none"> • Contact repair facility
Blows breaker	<ul style="list-style-type: none"> • Shorted armature • Brush dust accumulation in motor 	<ul style="list-style-type: none"> • Replace armature • Replace rear end bell and clean 	<ul style="list-style-type: none"> • Contact repair facility • Contact repair facility
Blows breaker, runs hot	<ul style="list-style-type: none"> • Mechanical overload operating range 	<ul style="list-style-type: none"> • Check load throughout 	<ul style="list-style-type: none"> • Contact original equipment manufacturer
Blows breaker, runs hot, motor shaft turns hard	<ul style="list-style-type: none"> • Bad bearing(s) 	<ul style="list-style-type: none"> • Motor may require overhaul 	<ul style="list-style-type: none"> • Contact repair facility

Maintenance

Brush and Commutator

Brushes must be inspected periodically to insure uninterrupted service. Damage to the commutator may occur if the brushes are allowed to wear down below 0.56 inch minimum length. Brush life expectations vary based on speed and load. Generally, high speed and high current (periodically over nameplate rating) operation will cause higher wear on the brushes. Also, high brush or commutator wear may be experienced in light load (continuously below nameplate rating) situations. To avoid damage to the motor, a preventive maintenance inspection interval should be determined for each new application. You are encouraged to inspect the brushes and commutator after 500 hours of use. The brush length after 500 hours versus length when new can be used to project an appropriate maintenance schedule. The length (when new) of the most widely used brush for brush access motors is 1.03 inches. Non-brush access motors typically use a brush that is .88 inches long when new. Minimum brush length for all brush types is 0.56 inch. Always clean out brush dust when inspecting or changing brushes. When inspecting brushes, check the commutator for wear. If the commutator is worn more than 0.031 inch (measured on the

diameter) or it is pitted, turning and undercutting is recommended. This can be accomplished by a reputable motor repair facility. Usually three sets of brushes can be used for one commutator turning.

Motor Breakdown

Review the following motor figures prior to beginning replacement procedures. These diagrams show the major components of the motor, brush and spring positioning, and the parts terminology, which will be beneficial in understanding the procedures.

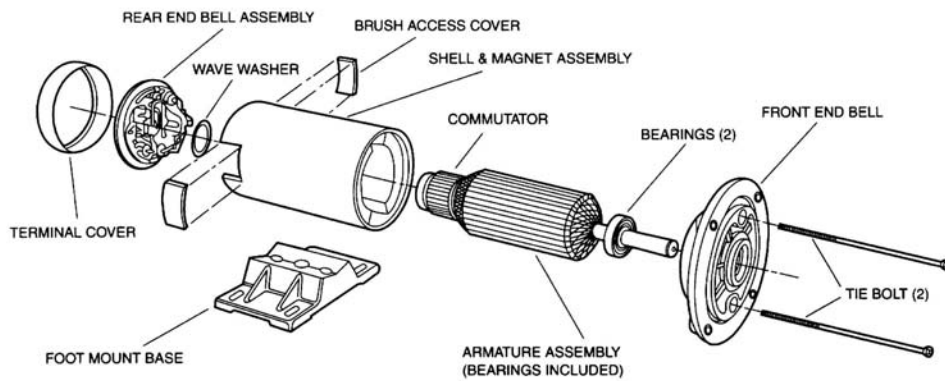


Figure 1 Exploded View

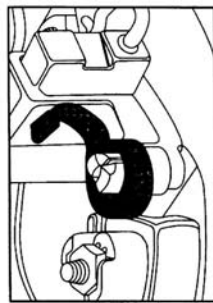


Figure 2 Brush removal / installation integral brush spring

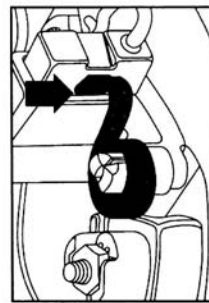


Figure 3 Integral brush spring cocked for assembly

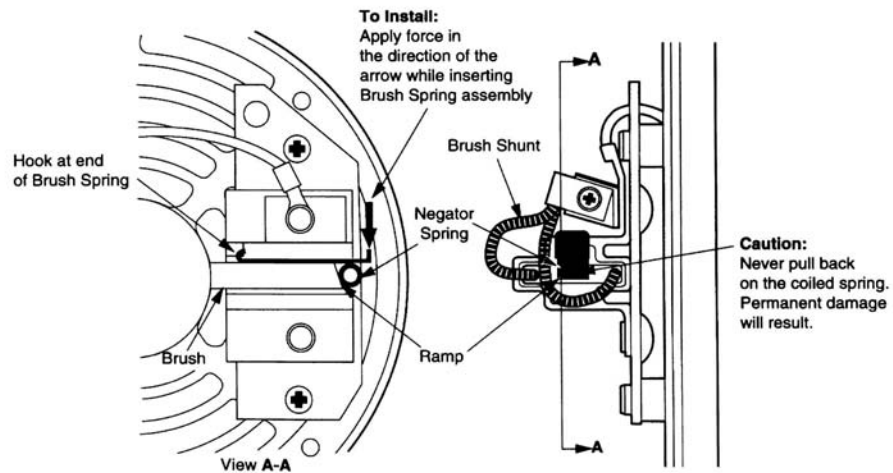


Figure 4 Brush removal / installation, Negator style spring

Brush replacement procedures

Motors with brush access covers.

Motors with Negator style springs.

(Typically motors larger than 1 horsepower)

1. Disconnect motor from the power source.
2. Remove each brush cover and any insulators if used.
3. Move the brush shunts out of the way from the spring.
4. Note the brush ramp position and negator spring location prior to removing the brushes. You will need to duplicate these positions when installing the new brushes.
5. Push the negator spring handle until you hear a click. The spring is now disengaged from the brush holder.
6. Carefully remove the spring (Do not pull on the coiled spring.) Disconnect the brush shunt from the brush holder and remove brush.
7. Carefully remove any brush dust accumulation from the inside of the motor. A soft brush and compressed air might be helpful.
8. Place new brushes in the brush holder. Remember to position the ramp exactly the same as the brush you removed.
9. Install the negator spring assembly so that the bottom of the brush ramp is closest to the spring assembly.
10. While installing the negator spring you will need to apply force towards the brush (see Figure 4) to ensure the hook on the end of the spring engages with the brush holder.
11. Connect the brush shunts and install any insulators and brush covers.

Motors with brush springs integral to brush holder.

(Typically motors 1 horsepower and below)

1. Disconnect motor from the power source.
2. Remove each brush cover and lift the white insulator flap out of the way.
3. Pull the end of the spring from the top of each brush and place the end of the spring on the step of the casting so that it is out of the way for brush replacement (reference Figure 2).
4. Remove the brush shunt connection. Some brush connections will use a .250 quick disconnect, others will use a spade lug. For the quick disconnect style simply pull on the shunt terminal to remove. The spade lug will require the power connection stud to be loosened.
5. Note the brush ramp orientation and remove each brush.
6. Carefully remove any brush dust accumulation from the inside of the motor. A soft brush and compressed air might be helpful.
7. Replace with new brushes and reposition the end of the spring on the top of each brush.
Caution: Orient the brush in the brush guide so the bottom of the ramp is adjacent to the brush spring and the brush shunt is closest to the end bell (reference figure 2).
8. Reconnect the brush shunts.
9. Reposition the insulator flaps and reinstall the brush covers.

Motors without brush access covers.

1. Disconnect motor from the power source.
2. Remove the terminal cover.
3. Place a reference mark on the edge of the rear end bell near the alignment key that fits into the notch in the housing. This will ensure proper assembly when maintenance is complete.
4. Remove the two nuts holding the rear end bell in place and remove the assembly.
5. Lift the white insulator flap out of the way.
6. Carefully pull the end of the spring from the top of each brush. Place the end of the spring on the step of the casting so that it is out of the way for brush replacement (reference Figure 2).
7. Slightly loosen the power connection stud and disconnect the brush shunt.
8. Note the brush ramp orientation and remove each brush.
9. Carefully remove any brush dust accumulation from the inside of the motor. A soft brush and compressed air might be helpful.
10. Replace with a new brush.
Caution: Orient the brush in the brush guide so the bottom of the ramp is adjacent to the brush spring and the brush shunt is closest to the end bell (reference figure 2).
11. Place the spade lug under the power connection stud and tighten.
12. Before reinserting the end bell assembly, each brush must be held in position in the brush guide to allow clearance for the commutator. Brush position can be maintained by cocking the spring against the side of the brush (see figure 3).
13. Install the wave washer in the bearing bore (if it has fallen out) before replacing the end bell.
14. Partially install the end bell so the brushes are over the commutator. Uncock the brush by pushing in the brush until the spring clicks into the notch on top of each brush. This seats the brush on the commutator.
15. Reposition the insulators.
16. Insure that the key of the end bell is in the shell notch (see your reference mark) to prevent the motor from running in the reverse direction.
17. Tighten the two tie bolts to secure the end bell and replace the terminal cover.

Warranty Policy / Return Authorization

Pacific Scientific will repair or replace (at its option), at the factory, motor or motor parts which prove to be defective as a result of materials or workmanship provided that written notice be given to Pacific Scientific within two years after the date of the product date code that is affixed to the product. This warranty does not include brush or commutator wear since wear is normal. The foregoing is a summary of the warranty policy. For the complete Warranty and Limitation of Liability, contact the factory. Before returning any products for repair, authorization must first be received from Customer Service (815/226-3044). A Return Material Authorization number (RMA) will be issued that must appear on the outside of the (freight prepaid) package.



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Rockford, IL 61105-0106
(815) 226-3100 FAX (815) 226-3080

JT91330 98-9-1.5M PRINTED IN U.S.A.

APPENDIX 2: GEAR REDUCERS

A: Morse Gearbox



Emerson Power Transmission
 P O Box 687
 MAYSVILLE, KY 41056
 Phone: 606-564-2093
 www.emerson-ept.com

FORM
8756
Revised
March, 2003

	WARNING	
High voltage and rotating parts may cause serious or fatal injury. Turn off power to install or service. Operate with guards in place. Read and follow all instructions.		

This Lubrication Bulletin is for MORSE Standard Product Line Worm Gear Reducers only. For lubrication information regarding other reducers consult the appropriate lubrication bulletin.

USE ONLY WORM GEAR OIL IN WORM GEAR REDUCERS. SEE CHART FOR BRAND NAME RECOMMENDATIONS.

Normal operating temperature of a worm gear reducer is less than 200° F but during initial break-in the temperature may exceed 200°F. After break-in is completed the temperature will fall below 200°F. If temperature exceeds 200°F for greater than 100 hours consult factory.

MAINTENANCE SCHEDULE

1. Change initial oil fill after 500 hours service or 5 weeks.
2. Change oil every 2500 hours service or 6 months. If severe operating conditions exist, change the oil every 1 to 3 months.
3. Grease all grease fittings every 1000 hours of operation with 1 -2 ounces of grease meeting NLGI #2 standards.

ADDITIONAL LUBRICATION NOTES:

1. **90 WEIGHT OIL AND EP OILS ARE NOT RECOMMENDED.**
2. For ambient temperatures -40°F to 15°F use Mobil SHC634 or equivalent.
3. Units running at slow speeds (less than 100 RPM input) should carry extra high oil level and in ambient temperatures of 15 to 125° F. use an AGMA # BC lubricant.
4. "RW" reducers use a dipstick to measure oil level, all other units have an oil level pipe plug.
5. On double reduction units check the oil level in both housings. On some configurations the lower housing must be completely full and the upper housing filled to normal oil level.
6. Most units are shipped with vent plug installed in proper position based on mounting position ordered. If vent plug is not installed in unit it will be included in the packing. Install the vent plug in the topmost pipe plug position.

See page two for reducer oil capacities.

The companies and oil shown below are typical. Any other make of oil meeting American Gear Manufacturers Association (AGMA) standards #7C & #8C will be satisfactory. Consult factory if you have any questions.

Viscosity Range MM/S at 40° C ISO Grade	Ambient Temp. 15 to 60° F 414-506 460	Ambient Temp. 50 to 125° F 612-748 680
Oil Company Name	AGMA # 7C	AGMA # 8C
Amoco Oil Co.	Amoco Worm Gear Oil	Amoco Cyl. Oil 680
Atlantic Richfield (Arco)		Modoc 175
Chevron Oil Co.	Cylinder Oil 460X	Cylinder Oil 680X
Conoco Oil Co.	Inca Oil	
Exxon Oil Co.	Cylesstic TK460	Cylesstic TK680
Fiske Brothers	SPO 277	SPO 288
Gulf Oil Co.	Senate 460	Senate 680
Gulf-Canada	Senate 460	Senate 680
Keystone=Penwalt	Keygear K-600	
Mobil Oil Corp.	Mobil 600W Super Cyl. Oil	Mobil Extra Hecla Super Cyl. Oil
Pennzoil	Cyl. Oil # 8	Cyl. Oil # 6
Phillips Petroleum Co.	Hector 460S	Hector 630S
Shell Oil Co.	Valvata Oil J460	Valvata Oil J680
Sohio	Energol DC-600C	Energol DC-600C
Texaco Inc.	Vanguard 460	Honor 680
Union Oil Co. of Calif.	Steaval B110	Steaval B1 65

The Company names and the names of the Lubricants mentioned above are the tradenames, trademarks and logotypes of the respective companies, and are not owned by EPT.

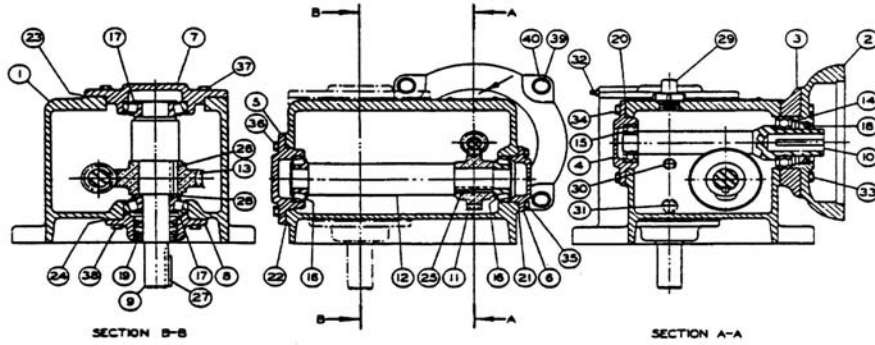
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OIL CAPACITIES CHART - USA MEASURE - APPROXIMATE QUANTITIES - FILL TO OIL LEVEL

10WB	1/4 PT	21LB	1 PT	30V	1 3/4 QTS	40GDSA &	4 1/4 QTS	Inverted	3 1/4 GALS
10WT	1/4 PT	21LDB	1 1/4 PTS	30VX STD	3 QTS	GDSF		60GCT	2 3/4 GALS
10WV	1/4 PT	21LDV	1 PT	Inverted	2 QTS	40GSA&GSF	3 1/2 QTS	60GCV	2 3/4 GALS
13GCDB	3/4 PT	21LT	3/4 PT	30WDB	2 1/2 QTS			Low Base	2 3/4 GALS
13GCDV	3/4 PT	21LV	3/4 PT	30WDV	2 1/4 QTS	40RWB	3 1/2 QTS	60GDSA &	2 3/4 GALS
13GCT	1/2 PT	25DSA&DSF	3 1/4 PTS	35DSA&DSF	2 3/4 QTS	40RWT	3 1/2 QTS	GDSF	
13GCV	1/2 PT	25DV	1 1/4 QTS	35DV	2 3/4 QTS	40RVV	3 QTS	60GSA&GSF	2 3/4 GALS
Low Base	1/2 PT	25GCDB	3 1/4 PTS	35DVX STD	4 1/2 QTS	40SA&SF	3 1/2 QTS	60RWB	2 3/4 GALS
13WB	1/2 PT	25GCDV	1 1/4 QTS	Inverted	4 QTS	40V	3 1/2 QTS	60RWT	3 GALS
13WT	1/2 PT	25GCT	1 1/4 QTS	35GCDB	3 3/4 QTS	40VX STD	1 1/4 GALS	60RVV	2 1/2 GALS
13WV	1/2 PT	25GCV	1 1/2 QTS	35GCDV	2 3/4 QTS	Inverted	1 GAL	60SA&SF	2 3/4 GALS
16LDB	3/4 PT	Low Base	1 1/2 QTS	35GCDVX		40WDB	3 3/4 QTS	60V	2 1/2 GALS
17LB	1/4 PT	25GDSA &	3 1/4 PTS	STD	4 1/2 QTS	40WDV	3 1/4 QTS	60VX STD	3 3/4 GALS
17LT	1/4 PT	GDSF		Inverted	4 QTS	50DSA&DSF	2 1/4 GALS	Inverted	2 3/4 GALS
17LV	1/4 PT	25GSA&GSF	1 1/4 QTS	35GCT	3 QTS	50DV	1 3/4 GALS	60WDB	3 3/4 GALS
18DSA&DSF	1 PT	25RWB	2 1/2 PTS	35GCV	3 3/4 QTS	50DVX STD	2 1/4 GALS	60WDV	3 1/2 GALS
18GCDB	1 PT	25RWT	2 1/2 PTS	Low Base	3 3/4 QTS	Inverted	2 GALS	70DV	4 1/2 GALS
18GCDV	1 PT	25RVV	2 1/4 PTS	35GDSA &	2 3/4 QTS	50GCDB	2 1/4 GALS	70DVX STD	7 GALS
18GCT	3/4 PT	25SA&SF	1 1/4 QTS	GDSF		50GCDV	1 3/4 GALS	Inverted	5 1/2 GALS
18GCV	1 PT	25V	1 QT	35GSA&GSF	3 QTS	50GCDVX		70RWB	5 3/4 GALS
Low Base	1PT	25WDB	3 1/4 PTS	35RWB	3 1/4 QTS	STD	2 1/4 GALS	70RWT	5 3/4 GALS
18GDSA &	1 PT	25WDV	3 PTS	35RWT	3 1/2 QTS	Inverted	2 GALS	70RVV	4 1/2 GALS
GDSF		26LB	1 1/2 PTS	35RVV	2 1/2 QTS	50GCT	1 3/4 GALS	70V	4 GALS
18GSA&GSF	3/4 PT	26LDB	1 3/4 PTS	35SA&SF	3 QTS	50GCV	1 1/2 GALS	70VX STD	6 GALS
18SA&SF	3/4 PT	26LDV	1 1/2 PTS	35V	2 1/4 QTS	Low Base	1 1/2 GALS	Inverted	5 GALS
18V	1 PT	26LT	1 1/2 PTS	35VX STD	4 1/4 QTS	50GDSA &	2 1/4 GALS	70WDB	7 GALS
18WB	1 PT	26LV	1 1/4 PTS	Inverted	3 3/4 QTS	GDSF		70WDV	6 1/4 GALS
18WT	3/4 PT	30DSA&DSF	2 1/2 QTS	35WDB	3 3/4 QTS	50GSA&GSF	1 3/4 GALS	80RWB	7 1/2 GALS
18WV	1 PT	30DV	2 1/2 QTS	35WDV	3 QTS	50RWB	1 3/4 GALS	80RWT	7 1/2 GALS
20DSA&DSF	1 QT	30DVX STD	3 3/4 QTS	37LB	1 1/2 QTS	50RWT	1 3/4 GALS	80RVV	6 1/2 GALS
20DV	1 QT	Inverted	2 3/4 QTS	37LDB	2 QTS	50RVV	1 1/2 GALS	80WDB	10 GALS
20GCDB	1 QT	30GCDB	2 1/2 QTS	37LDV	2 QTS	50SA&SF	1 3/4 GALS	80WDV	9 GALS
20GCDV	1 QT	30GCDV	2 1/2 QTS	37LT	1 1/2 QTS	50V	1 1/2 GALS	90DVX	12 1/2 GALS
20GCT	1 1/2 PTS	30GCDVX STD	3 3/4 QTS	37LV	1 1/4 QTS	50VX STD	2 GALS	90VX	11 GALS
20GCV	1 QT	Inverted	2 3/4 QTS	40DSA&DSF	4 1/4 QTS	Inverted	1 3/4 GALS	100RWB	15 1/2 GALS
Low Base	1 QT	30GCT	2 QTS	40DV	4 1/4 QTS	50WDB	2 1/4 GALS	100RWT	11 1/2 GALS
20GDSA	1 QT	30GCV	2 1/2 QTS	40DVX STD	1 1/2 GALS	50WDV	2 GALS	100RVV	10 GALS
20GSA&GSF	1 1/2 PTS	Low Base	2 1/2 QTS	Inverted	1 1/4 GALS	60DSA&DSF	3 3/4 GALS	100WDB	19 GALS
20SA&SF	1 1/2 PTS	30GDSA &	2 1/2 QTS	40GCDB	3 3/4 QTS	60DV	2 3/4 GALS	100WDV	12 1/2 GALS
20V	1 1/2 PTS	GDSF		40GCDV	4 1/4 QTS	60DVX STD	4 1/4 GALS	110DVX	18 1/2 GALS
20WB	1 3/4 PTS	30GSA&GSF	2 QTS	40GCDVX STD	1 1/2 GALS	Inverted	3 1/4 GALS	110VX	22 GALS
20WDB	2 PTS	30RWB	3 3/4 PTS	Inverted	1 1/4 GALS	60GCDB	3 3/4 GALS		
20WDV	1 3/4 PTS	30RWT	3 3/4 PTS	40GCT	3 1/2 QTS	60GCDV	2 3/4 GALS		
20WT	1 1/2 PTS	30RVV	3 1/4 PTS	40GCV	3 1/2 QTS	60GCDVX			
20WV	1 1/2 PTS	30SA&SF	2 QTS	Low Base	3 1/2 QTS	STD	4 1/4 GALS		

▲WARNING Disconnect all power before adjusting units



**** UNIT: 18GCDV ****

AB-156

NO	NAME OF PART	PART NO	QTY
1	HOUSING	DJ00156	1
2	NTR ADAPTER	D100209	1
3	NTR ADAPTER SPACER	D100268	1
4	BRG CARR INPT BLIND	D100284	1
5	COVER CARR SEC WORM	D100330	1
6	BRG RET SEC WORM	DJ00324	1
7	COV CARR UPPER OPT BL	DJ00488	1
	OPT OPEN	DJ00480	
8	BRG RET LOWER OPT OPN	DJ00463	1
	LOWER OPT BL	DJ00471	
9	OUTPUT SHAFT SGL DN	DJ00594	1
	DOUBLE	DJ00578	
	SGL UP	DJ00586	
10	INPUT WRM 5/8 BORE	D100719	1
		D100735	
		D100743	
		D100751	
		D100760	
		D100778	
		D100786	
		D100794	
		D100807	
11	PRIMARY GEAR	D100874	1
		D100891	
		D100903	
		D100911	
		D100920	
		D100938	
		D100946	
		D100954	
		D100962	
12	SECONDARY WORM	DJ00851	1
		DJ00869	
		DJ00877	

NO	NAME OF PART	PART NO	QTY
13	SECONDARY GEAR	60 DJ00885	1
		15 DJ00949	
		20 DJ00957	
		25 DJ00965	
		60 DJ01001	
14	BEARING INPUT 910SKDD	FF00020	1
15	BEARING INPUT 202KDD	FF30118	1
16	BRG SEC WRM A6157 CUP	FF00525	2
	A6067 CONE	FF00533	2
17	BRG OUTPUT 05185 CDP	FF00656	2
	05079 CONE	FF00664	2
18	OIL SEAL INPUT 471571	FG00155	1
19	OIL SEAL OPT 481433	FG00315	2
20	SBIM INPUT	FI03139	SET
21	SBIM SEC RET	FI03059	SET
22	SBIM SEC COVER CARR	FI03913	SET
23	SBIM OPT COVER CARR	FI03956	SET
24	SBIM OUTPUT RET	FI03139	SET
25	KEY - PRIM GEAR	FB00041	1
26	KEY - SEC GEAR	FB00295	1
27	KEY - OUTPUT	FB00148	1
28	SPACER	NOT REQD	1
29	OIL FILL PLUG	FK00122	1
30	OIL LEVEL PLUG		1
31	OIL DRAIN PLUG		1
32	GREASE FITTING		1
33	CAP SCREW		4
34	CAP SCREW		4
35	CAP SCREW		4
36	CAP SCREW		4
37	CAP SCREW		4
38	CAP SCREW		4
39	CAP SCREW		4
40	LOCKWASHER		4
	NAMEPLATE	FN00022	1

AP-361



**700 Series
Worm Gear Speed Reducers**

**INSTALLATION, LUBRICATION,
OPERATION INSTRUCTIONS and
PARTS**

CONTENTS

General Instructions 1
Lubrication Instructions 1
Oil Capacities 2
Recommended Lubricants 2
Lubricant Interchange 2
Single Reduction Parts List 3-4
Double Reduction Parts List 5-6

These instructions must be read thoroughly before installing or operating speed reducers. File instructions for future reference and for ordering of replacement parts.

General Instructions

1. Leave protective sleeves on shafts for safer handling of speed reducers during installation. The sleeves are provided to protect your hands from potential sharp edges on keyways.
2. Align all shafts accurately. Improper alignment can result in failure. Use of flexible couplings is recommended to compensate for slight misalignment.
3. When mounting, use maximum possible bolt size and secure reducer to a rigid foundation. Periodic inspection of all bolts is recommended.
4. Auxiliary drive components (such as sprockets, gears and pulleys) should be mounted on the shafts as close as possible to the housing to minimize effects of overhung loads. Avoid force fits that might damage bearings or gears.
5. For hollow-shaft speed reducers, place speed reducer as close as possible to supporting bearing on driven shaft. Spot-drill driven shaft for setscrews in severe applications. See kit instructions for reaction rod assembly.
6. Check and record gear backlash at installation and again at regular intervals. This should be done by measuring the rotary movement of the output shaft (rotating alternately clockwise and counterclockwise) at a suitable radius while holding the input shaft stationary. Gears should be replaced when the backlash exceeds four times the measurement taken at installation.
7. Gear drives are rated for 1750 input RPM and Class I Service (Service Factor 1.0), using Mobil SHC634 synthetic lubricant. For lower input speeds or for different service classes or lubricants, see catalog selection pages for rating information.
8. Initial operating temperatures may be higher than normal during the break-in period of the gear set. FOR MAXIMUM LIFE, DO NOT ALLOW THE SPEED REDUCER TO OPERATE CONTINUOUSLY ABOVE 225° F AT THE GEAR CASE. In the event of overheating, check for overloads or high ambient temperatures. Keep shafts and vent plugs clean to prevent foreign particles from entering seals or gear housing.
9. All reducers should be checked to see if they have been lubricated. Prelubed 700 Series reducers will have a solid plug in the vent hole which must be replaced by the vent plug at time of installation.

CAUTION

- For safe operation of any gear drive, all rotating shafts and auxiliary components must be shielded to conform with applicable safety standards. You must consider overall operational system safety at all times.
- When using a speed reducer to raise or lower a load, such as in hoisting applications, provision must be made for external braking. Under no conditions should a speed reducer be considered self-locking.
- Mounting of speed reducers in overhead positions may be hazardous. Use of external guides or supports is strongly recommended for overhead mounting.

Instructions for Flanged Models

F700 (Quill Type Input)

1. Assemble the key to the motor shaft and coat the shaft with anti-seize compound. Insert the motor shaft into the reducer input shaft.
2. Rotate the motor to proper position and firmly secure to flange with four hex-head cap screws.

RF700 (Coupling Input - 3-Jaw Type FC)

1. Coat reducer input and motor shaft with anti-seize compound.
2. Position coupling half on input shaft with shaft flush to end of coupling bore.
3. Locate remaining half on motor shaft, with 1/32" clearance between jaw surfaces.
4. Tighten setscrews securely. For reversing applications, a thread-locking compound is recommended.
5. Install coupling insert and position motor. Rotate motor to proper position and firmly secure to flange.

CAUTION - If the motor does not readily seat itself, check to determine if key has moved axially along motor shaft, causing interference. Staking of the keyway adjacent to the motor key will facilitate this procedure.

Lubrication Instructions

WARNING

- Boston Gear speed reducers are normally shipped without lubricant. They must be filled to the proper level with the recommended lubricant for your application before operation.
- Speed Reducers which have been pre-lubricated at factory will not have the vent plug installed, remove solid plug and install the enclosed vent plug before operating.

The table on Page 2 indicates the type and viscosity of lubricant suitable for reducers operating at various temperatures.

Lubrication and maintenance instructions are provided with each speed reducer. These instructions should be followed for best results. It is important that the proper type of oil be used since many oils are not suitable for the lubrication of gears. Various types of gearing require different types of lubricants.

The lubricant must remain free from oxidation and contamination by water or debris, since only a very thin film of oil stands between efficient operation and failure. To assure long service life, the reducer should be periodically drained (preferably while warm) and refilled to the proper level with a recommended gear oil. Under normal environmental conditions oil changes are suggested after the initial 250 hours of operation and thereafter at regular intervals of 2500 hours or every 6 months.

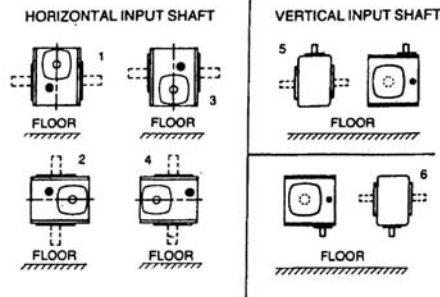
Synthetic lubricants will allow extended lubrication intervals due to its increased resistance to thermal and oxidation degradation. It is suggested that the initial oil change be made at 1500 hours and, thereafter, at 5000 hour intervals.

During the initial period of operation, higher than normal operating temperatures may be seen. This is due to the initial break-in of the worm gear set. The temperature of Double Reduction Worm Gear Reducers may reach 160° F and Single Reduction Worm Gear Reducers approximately 225° F.

Oil Capacities

SINGLE REDUCTION MODELS ONLY

OIL LEVELS FOR TYPICAL MOUNTING POSITIONS



OIL CAPACITY IN OUNCES

UNIT SIZE	POSITIONS			
	1	2 & 4	3	5 & 6
710	3.1	4.3	3.6	3.6
713	6.7	9.4	8.5	7.8
715	9.9	14.0	12.7	11.8
718	13.5	20.6	19.1	17.0
721	14.8	23.8	22.1	17.2
724	17.8	28.9	27.5	23.4
726	29.4	43.1	40.7	35.9
732	59.4	88.2	83.4	73.7
738	75.7	116.5	110.5	96.0
752	168.3	248.8	241.1	208.2
760	266.8	378.2	366.4	303.4

DOUBLE REDUCTION MODELS

The variety of mounting possibilities for double reduction drives makes it impractical to illustrate positions for these models. In general, the vent filler is at the uppermost plug position, and the drain plug at the lowest possible position. The oil level must be at the approximate centerline of the uppermost gear.

Recommended Lubricants

ENCLOSED WORM GEAR REDUCERS

AMBIENT (Room) TEMPERATURE	RECOMMENDED OIL (or equivalent)	VISCOSITY RANGE SUS @ 100° F	LUBRICANT AGMA NO.	ISO VISCOSITY GRADE NO. +
-30° to 225°F** (-34° to 107°C)	MOBIL SHC 634* SYNTHETIC	1950/2150	---	320/460
40° to 90°F (4.4° to 32.2°C)	MOBIL 600W CYLINDER OIL	1920/3200	7 or 7C	460
80° to 125°F (26.7° to 51.7°C)	MOBIL EXTRA HECLA SUPER CYLINDER OIL	2850/3600	8 or 8C	680

WORM GEAR LUBRICANTS AVAILABLE FROM BOSTON GEAR

ORDER BY ITEM CODE

TYPE	MOBIL SHC624		MOBIL 600W	
	QT.	GAL.	QT.	GAL.
ITEM CODE	51493	51494	27300	51492
Available in case lots only, i.e.:			55 GALLON DRUM	
12 Qts. / case			25536	
4 Gal. / case				

CAUTION: Relubricate more frequently if drive operated in high ambient temperatures or unusually contaminated atmosphere. High loads and operating temperatures will also require more frequent lubrication.

*Synthetic recommendation is exclusively for Mobil SHC634.

+Other lubricants corresponding to AGMA/ISO numbers are available from all major oil companies.

**The SHC lubricant will perform at temperatures considerable higher than 225°F. However, the factory should always be consulted prior to operating at higher temperature as damage may occur to oil seals and other components.

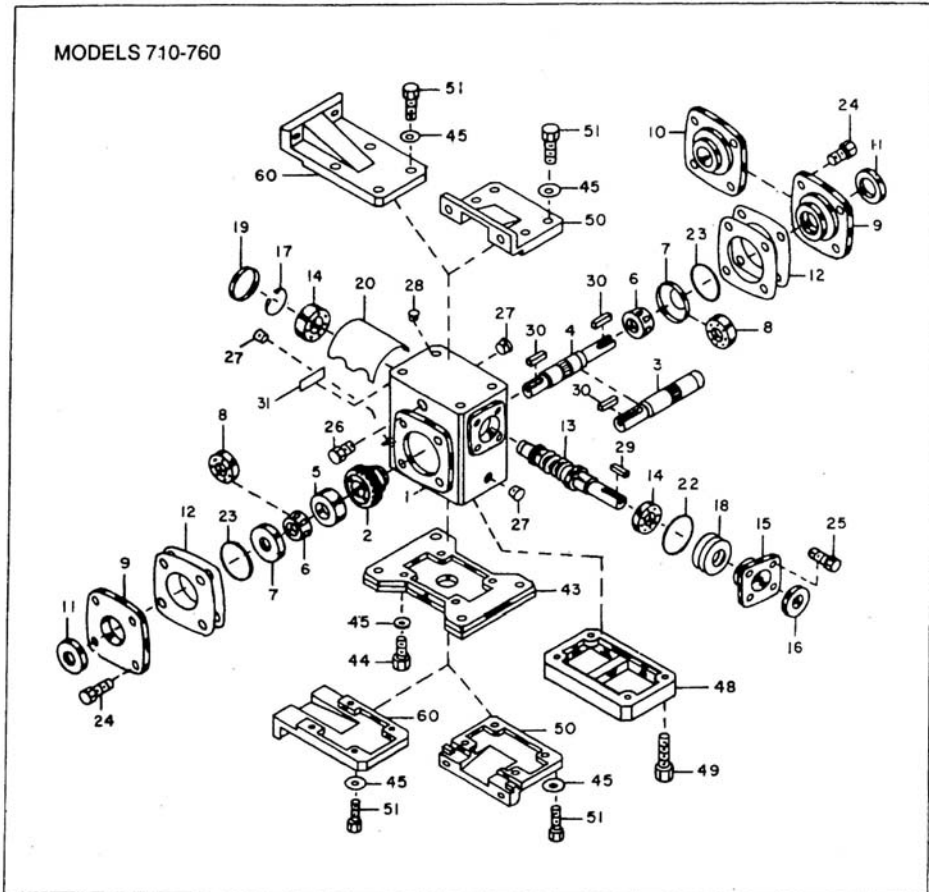
NOTE: AGMA lubricants stated above are preferred. Listed below are several of the many manufacturers, that have alternative AGMA lubricants.

Lubricant Interchange

1. Ambient temperature is based upon 1.0 service factor.
2. Lubricants are compounded for use in worm gears. Some contain non-corrosive, extreme pressure additives. DO NOT USE lubes that contain sulphur and/or chlorine which are corrosive to bronze gears. Extreme pressure lubes, in some cases contain materials that are toxic. Avoid use of these lubes where they can result in harmful effects. If in doubt, consult your lube supplier.

MANUFACTURER	LUBRICANT NAME	AGMA RATING
Getty Refining Co.	Veedol Asreslube 98	8 EP
Getty Refining Co.	Veedol Asreslube 95	7 EP
Getty Refining Co.	Veedol Asreslube 90	6 EP
Lubrication Engr. Inc.	Almasol 609	8
Lubrication Engr. Inc.	Almasol 608	7
Mobil Oil Corp.	Mobilgear 634	8 EP
Mobil Oil Corp.	Mobil Extra Hecla Super	8
Mobil Oil Corp.	Mobil Cylinder 600W	7
Shell Oil Co.	Ornala 460	7 EP
Shell Oil Co.	Valvata J460	7
Shell Oil Co.	Ornala 680	8 EP
Shell Oil Co.	Valvata J680	8
Texaco Inc.	Meropa 680	8 EP
Texaco Inc.	Meropa 460	7 EP

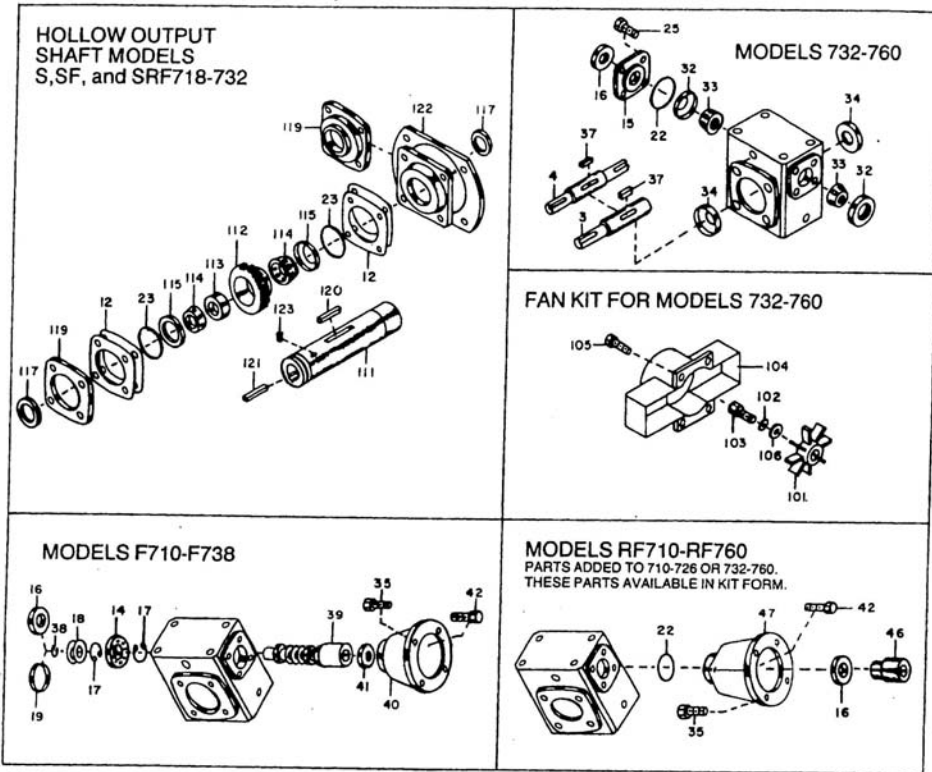
**700 SERIES WORM GEAR SPEED REDUCERS
PARTS LIST - SINGLE REDUCTION MODELS**



PART ORDERING INFORMATION

1. Be sure to provide complete Boston Gear catalog number from speed reducer nameplate, along with part description and number. For example, "One output oil seal, Part No. 11, for RF718-30-B5-G".
2. Output shaft components for Boston Gear models 710 through 726 are available only as complete assemblies that include Parts 2, 3, 5, 6, 11, 12 and 23 for single projecting shafts; and Parts 2, 4, 5, 6, 11, 12 and 23 for double projecting shafts. When ordering, specify "output shaft assembly" and full Boston Gear catalog number from nameplate.

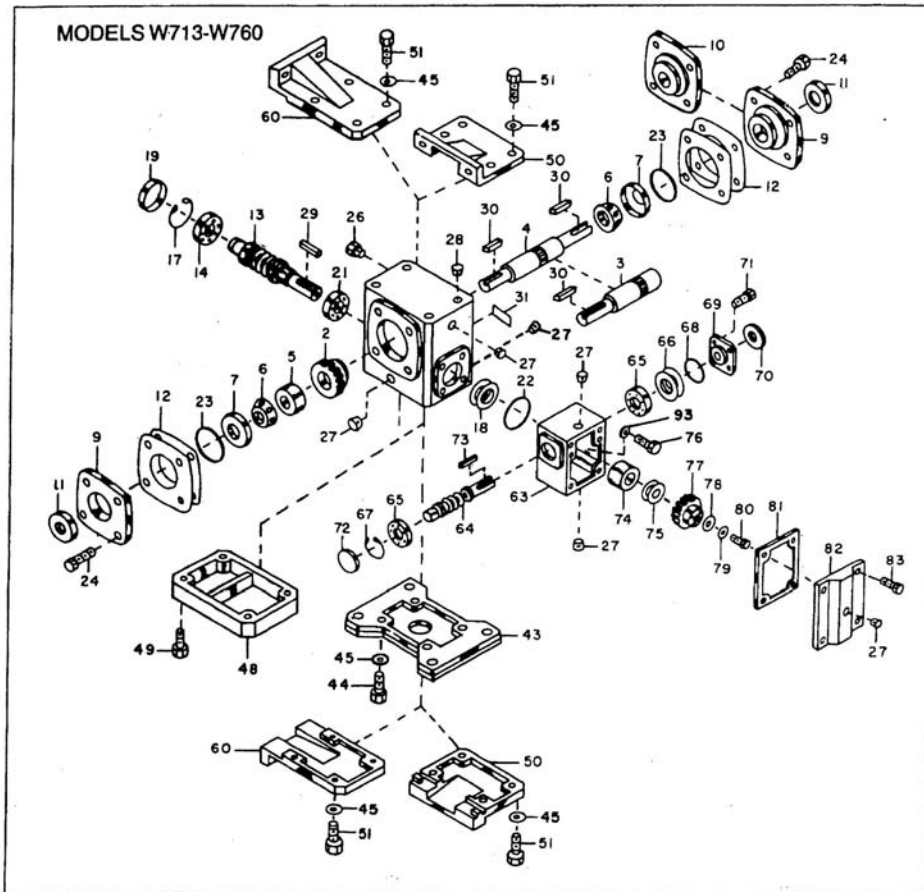
**700 SERIES WORM GEAR SPEED REDUCERS
OPTIONS & ACCESSORIES - SINGLE REDUCTION MODELS**



PART NO.	DESCRIPTION	PART NO.	DESCRIPTION	PART NO.	DESCRIPTION
1	HOUSING	26	VENT PLUG - 2 PIECE	51	HEX HEAD CAP SCREW
2*	WORM GEAR	27	PIPE PLUG	60	VERTICAL BASE (X & Y ASSEMBLY)
3*	SINGLE PROJECTING OUTPUT SHAFT	28	PROTECTIVE CAP PLUG	161	FAN
4*	DOUBLE PROJECTING OUTPUT SHAFT	29	INPUT KEY	102	SPACER
5*	GEAR SPACER	30	OUTPUT KEY	103	HEX HEAD CAP SCREW
6*	OUTPUT BEARING (CONE) - MODELS 713-760	31	NAMEPLATE	104	FAN GUARD
7	OUTPUT BEARING (CUP) - MODELS 713-760	32	INPUT BEARING (CUP) - MODELS 732-760	105	HEX HEAD CAP SCREW
8	OUTPUT BEARING (CONE) - MODELS 713-760	33	INPUT BEARING (CONE) - MODELS 732-760	106	WASHER
9	BEARING CARRIER (OPEN)	34	GREASE CUPS - MODELS 732-760	111	HOLLOW OUTPUT SHAFT
10	BEARING CARRIER (CLOSED)	35	HEX HEAD CAP SCREW	112	WORM GEAR
11*	OUTPUT OIL SEAL	37	OUTPUT SHAFT KEY - MODELS 732-760	113	GEAR SPACER
12*	ADJUSTMENT SHIMS	38	RETAINING RING - MODELS 710-738	114	OUTPUT BEARING (CONE)
13	INPUT WORM SHAFT	39	MOTOR SHAFT - MODELS 710-738	115	OUTPUT BEARING (CUP)
14	INPUT BEARING - MODELS 710-728	40	MOTOR FLANGE - MODELS 710-738	117	OIL SEAL
15	INPUT BEARING RETAINER	41	OIL SEAL - MODELS 710-738	119	BEARING CARRIER (OPEN)
16	INPUT OIL SEAL - MODELS 710-760	42	HEX HEAD CAP SCREW	120	KEY (EXTERNAL)
17	RETAINING RING	43	HORIZONTAL BASE	121	KEY (INTERNAL)
18	ADJUSTMENTS SHIMS	44	HEX HEAD CAP SCREW	122	"Y" TYPE BASE
19	SCREW PLUG - MODELS 710-728	45	LOCKWASHER	123	SOCKET SETSCREW
20	INTERNAL BAFFLE - MODELS 713-760	46	2 PIECE FC COUPLING - WITH INSERT		
22	INPUT "O" RING	47	RETAINING MOTOR FLANGE		
23*	OUTPUT "O" RING	48	RISE BLOCK		
24	HEX HEAD CAP SCREW	49	HEX HEAD CAP SCREW		
25	HEX HEAD CAP SCREW	50	VERTICAL BASE (#HIGH OR LOW)		

*For Models 710 to 726, these parts are available only as complete assemblies. See Part Ordering Information, #2, at left.

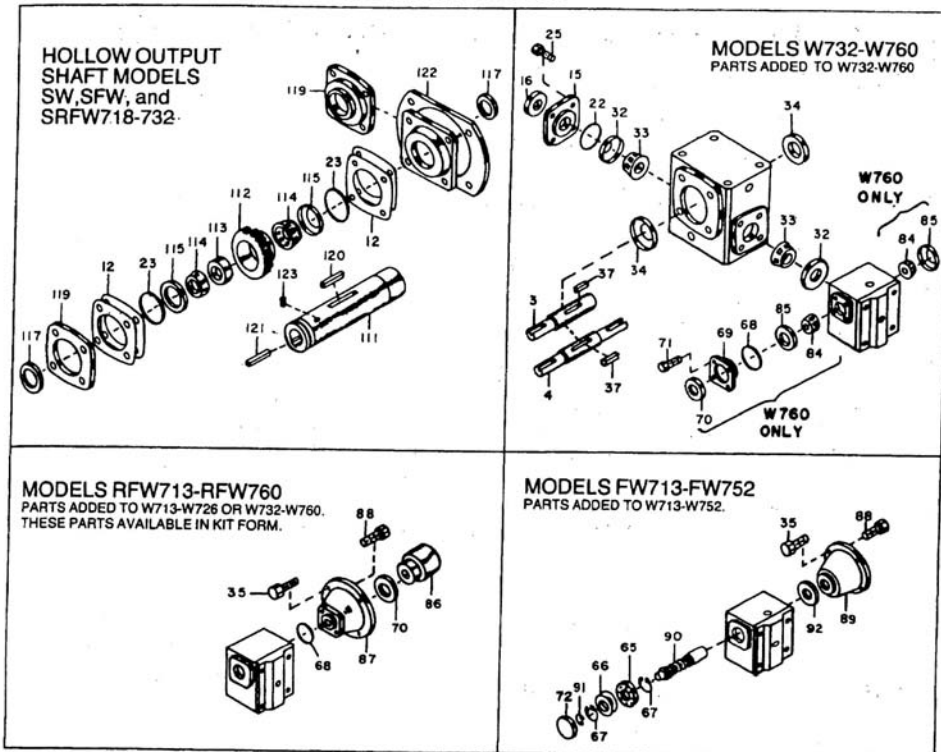
**700 SERIES WORM GEAR SPEED REDUCERS
PARTS LIST - DOUBLE REDUCTION MODELS**



PART ORDERING INFORMATION

1. Be sure to provide complete Boston Gear catalog number from speed reducer nameplate, along with part description and number. For example, "One output oil seal, Part No. 11, for W713-150-G".
2. Output shaft components for Boston Gear models 710 through 726 are available only as complete assemblies that include Parts 2, 3, 5, 6, 11, 12 and 23 for single projecting shafts; and Parts 2, 4, 5, 6, 11, 12 and 23 for double projecting shafts. When ordering, specify "output shaft assembly" and full Boston Gear catalog number from nameplate.

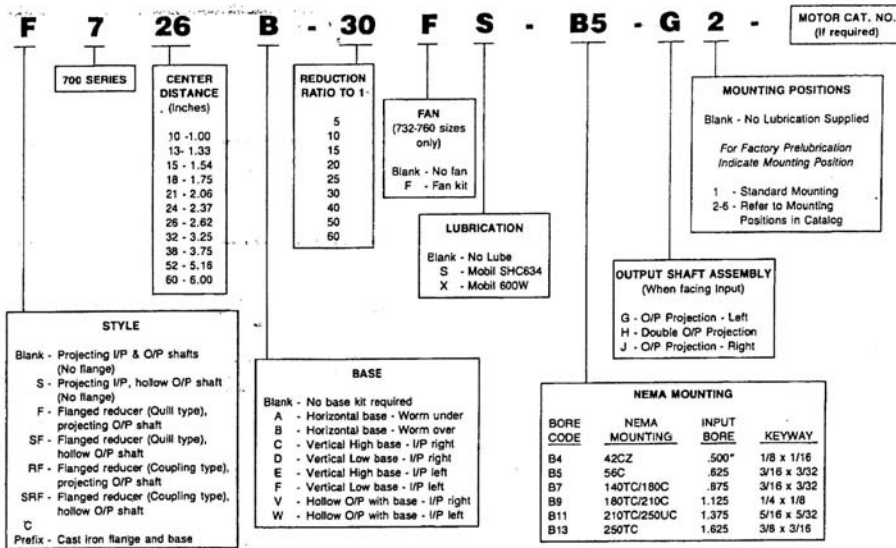
700 SERIES WORM GEAR SPEED REDUCERS



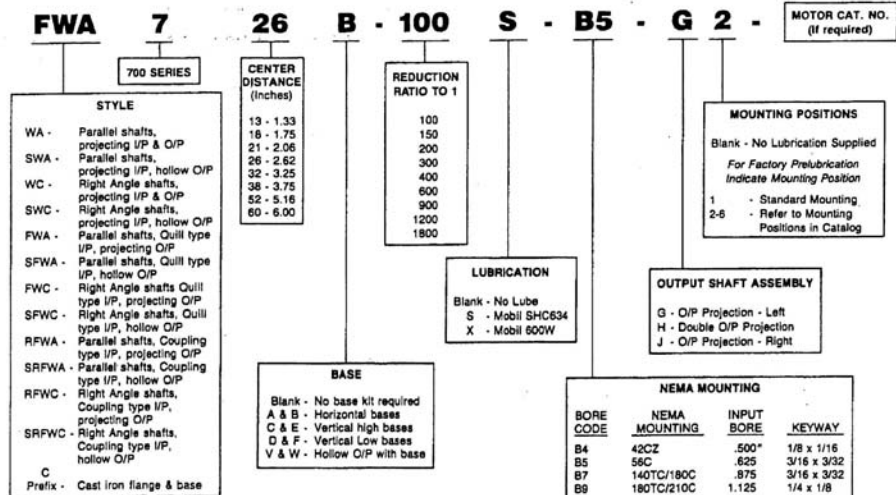
PART NO.	DESCRIPTION	PART NO.	DESCRIPTION	PART NO.	DESCRIPTION
1	HOUSING	31	NAMEPLATE	77	INTERMEDIATE WORM GEAR
2*	WORM GEAR	32	INTER. BEARING (CUP) - MODELS W732-W760	78	WASHER
3*	SINGLE PROJECTING OUTPUT SHAFT	33	INTER. BEARING (CONE) - MODELS W732-W760	79	LOCKWASHER
4*	DOUBLE PROJECTING OUTPUT SHAFT	34	GREASE CLIPS - MODELS W732-W760	80	HEX HEAD CAP SCREW
5*	GEAR SPACER	35	HEX HEAD CAP SCREW	81	ATTACHMENT COVER GASKET
6*	OUTPUT BEARING (CONE)	37	OUTPUT SHAFT KEY - MODELS W732-W760	82	ATTACHMENT COVER
7	OUTPUT BEARING (CUP)	43	HORIZONTAL BASE	83	HEX HEAD CAP SCREW
8	OUTPUT BEARING - MODEL 710 ONLY	44	HEX HEAD CAP SCREW	84	INPUT BEARING (CONE)-MODEL W760 ONLY
9	BEARING CARRIER (OPEN)	45	LOCKWASHER	85	INPUT BEARING (CUP) - MODEL W760 ONLY
10	BEARING CARRIER (CLOSED)	46	RISER BLOCK	86	TWO PIECE FC COUPLING WITH INSERT
11*	OUTPUT OIL SEAL	48	HEX HEAD CAP SCREW	87	MOTOR FLANGE
12*	ADJUSTMENT SHIMS	50	VERTICAL BASE (HIGH OR LOW)	88	HEX HEAD CAP SCREW
13	INTERMEDIATE WORM SHAFT	51	HEX HEAD CAP SCREW	89	MOTOR FLANGE
14	INTERMEDIATE BEARING-MODELS W713- W726	60	VERTICAL BASE (ASSEMBLY X & Y)	90	INPUT WORM SHAFT
15	INTER. BEARING RETAINER-MODELS W732-760	63	ATTACHMENT HOUSING	91	EXTERNAL RETAINING RING
16	INTER. OIL SEAL - MODELS W732-W760	64	INPUT WORM SHAFT	92	OIL SEAL - MODELS FW713-FW738
17	RETAINING RING - MODELS W713-W726	65	INPUT BEARING	93	WASHER
18	ADJUSTMENTS SHIMS	66	ADJUSTMENT SHIMS	111	HOLLOW OUTPUT SHAFT
19	BORE PLUG - MODELS W713-W726	67	RETAINING RING	112	WORM GEAR
21	INTERMEDIATE BEARING	68	O' RING	113	GEAR SPACER
22	INTERMEDIATE O' RING	69	BEARING RETAINER	114	OUTPUT BEARING (CONE)
23*	OUTPUT O' RING	70	OIL SEAL	115	OUTPUT BEARING (CUP)
24	HEX HEAD CAP SCREW	71	HEX HEAD CAP SCREW	117	OIL SEAL
25	HEX HEAD CAP SCREW	72	BORE PLUG - MODELS W713-W738	119	BEARING CARRIER (OPEN)
26	VENT PLUG - 2 PIECE	73	INPUT WORM SHAFT KEY	120	KEY (EXTERNAL)
27	PIPE PLUG	74	GEAR SPACER	121	KEY (INTERNAL)
28	PROTECTIVE OCAP PLUG	75	ADJUSTMENT SHIMS	122	"V" TYPE BASE
29	INTERMEDIATE KEY	76	HEX HEAD CAP SCREW		
30	OUTPUT KEY				

*For Models 710 to 726, these parts are available only as complete assemblies. See Part Ordering Information, Page 110.

700 SERIES SINGLE REDUCTION CATALOG NUMBER EXPLANATION



700 SERIES DOUBLE REDUCTION CATALOG NUMBER EXPLANATION



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TM-MRC-0592 (57746)
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REDUCER INSTALLATION, MAINTENANCE AND LUBRICATION

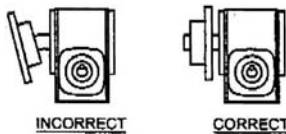
Baldor 900 Series reducers achieve maximum performance and life when installed properly. Please follow these instructions carefully.

INSTALLATION

Baldor 900 Series reducers filled with Kluber Klubersynth UH1-6-460 synthetic lubricant are ready for immediate use. These reducers are completely sealed and require no breather vents. The design and synthetic lubrication allow efficient operation to reduce operating temperature and minimize internal pressure build up. The reducer has been filled with the correct amount of oil for all approved mounting positions. Do not add or remove any oil during installation or after the break-in period.

Mount the reducer on a flat surface, to assure proper bolt tension and prevent damage to the mounting base. When direct coupling the reducer to the driven machine, carefully align the reducer output shaft to the input shaft of the driven machine. These shafts must be connected with a flexible coupling.

Power transmission components, such as sprockets, gears, or sheaves, mounted on the reducer shafts produce overhung loads. Mount these components as close as possible to the reducer with the hub facing outward. This mounting minimizes the load on the reducer shaft and bearings for increased life. Carefully align these components with their counterparts on the driven machine.



MAINTENANCE

Baldor 900 Series reducers require no periodic maintenance. Visual inspection (for oil leakage and general operating condition) and a simple cleaning to remove dirt build up is recommended.

Accumulation of material on the reducer can lead to overheating and reduced life.

LUBRICATION

Klubersynth UH1-6-460 is suitable for USDA Class H1 environments. This synthetic lubrication does not require periodic changing. The lubrication should only be replaced when maintenance is performed that requires disassembly. Use only Klubersynth UH1-6-460. This lubrication is suitable for a wide temperature range (-13° to 320° F). However, refer to "**Operating Environment**" section for the ambient operating temperature for Baldor 900 Series speed reducers.

A packet of Fel-Pro C5-A Anti-Seize Lubricant is supplied with the reducer. Lubricate the motor shaft and key with the anti-seize lubricant before installing the motor onto the reducer.

MOUNTING POSITIONS

For maximum seal life, the reducer should be mounted with the input shaft as high as possible. **Mounting the reducer with the input seal vertically down is not recommended.** If a vertically down input shaft position is required, consult the factory.

OPERATING ENVIRONMENT

Baldor Reducers are designed to operate in ambient temperatures of -10°F to 100°F. The oil sump temperature of the reducer must not exceed 200°F. Consult the factory for applications requiring ambient operating temperature outside this range.

The input horsepower rating shown on the nameplate of each Baldor 900 Series speed reducer is the continuous mechanical rating of 1.0 service factor at 1750 RPM. Before placing the reducer into service, confirm that its horsepower rating is consistent with the motor horsepower and desired service factor. Service factor and speed reducer ratings can be found in your Baldor Gear Product brochure, BR1600.